6

Spent Nuclear Fuel and High-Level Radioactive Waste

6. SPENT NUCLEAR FUEL AND HIGH-LEVEL RADIOACTIVE WASTE

6 (1091)

Comment - EIS000217 / 0003

Waste should be reclassified to reflect longevity and hazard. Wastes that threaten to exacerbate environmental contamination in the short- and medium- term should be stabilized and retrievably stored, pending long-term disposal.

Response

The Final EIS includes a new "representative" commercial fuel for the purposes of calculating impacts of repository and transportation accidents. The representative fuel is based on a Hazard Index approach, which considers the relative hazard of all commercial spent nuclear fuel to be received at the repository. This fuel is younger and has higher burnup than the "typical" commercial fuels used in the Draft EIS. DOE has revised Section J.1.4.2 in the Final EIS to be consistent with the Appendix A numbers for "representative" commercial pressurized-water reactor fuel. Regarding longevity, these materials are too similar in how long they are hazardous (well beyond any regulatory period) to provide for reasonable differentiation.

All spent nuclear fuel and high-level radioactive waste would be required to meet acceptance criteria prior to receipt at the proposed repository. One of these requirements is that the waste be inherently stable.

6 (1327)

Comment - EIS000268 / 0001

The DEIS provides insufficient information on the radiological characteristics of spent nuclear fuel (SNF) and high-level radioactive waste (HLW). During the scoping process in 1995, Nevada recommended that the DEIS provide technical data on each type of SNF and HLW shipped to the repository, especially "Key radiological characteristics: total radioactivity, radionuclide composition, surface dose rate, thermal output, and changes over time in each of these characteristics.

The DEIS identifies appropriate typical fuel types for pressurized-water reactor (PWR) and boiling water reactor (BWR) SNF, [p. A-14] typical HLW canister types, [Pp. A-38 to A-42] waste forms representative of eleven DOE SNF categories [p. A-23] and commercial greater-than-Class-C waste [Pp. A-57 to A-58]. The DEIS provides adequate information on the projected inventories, physical dimensions, and thermal characteristics for most, but not all, of these waste forms.

In sharp contrast, the DEIS provides insufficient and inconsistent technical data on the radiological characteristics of the designated "typical" waste forms. The DEIS inexplicably fails to provide such critical information as the total activity (in curies) and the surface dose rate (in rems per hour) for the "typical" PWR and BWR SNF assemblies, and for mixed-oxide (MOX) SNF fuel, as a function of initial enrichment burnup history, and cooling times. Where the DEIS attempts to provide useful information on the radioactive material content of loaded rail casks in Table J-14, the data on commercial SNF is either incorrect or in conflict with the data presented in Table A-8. The DEIS makes no attempt to provide comparable data on the radiological characteristics of truck casks loaded with various waste types.

Response

The level of radiological information provided in Appendix A of the EIS is sufficient to assess the environmental impacts both of the Proposed Action to construct, operate and monitor, and eventually close a geologic repository and of No-Action Alternative. Appendix A provides a substantial amount of information on the types and amounts of radioactivity involved in each waste form. The waste inventory information in Appendix A includes the final waste form, physical characteristics, mass, volume, amount and nature of radioactivity, chemical composition, thermal output, and canister data.

For dose and dose rate information, see Section F.2.2.3 of the EIS for radiological exposure data from shielded waste packages used to determine human health impacts for normal repository operations. Appendix H provides individual and collective doses for repository accident scenarios. For transportation dose information, Appendix J indicates that the maximum dose rate permitted by regulation on a transportation cask is very conservatively assumed.

Table J-14 of the Draft EIS has an error in footnote (a); specifically, the source is actually estimated based on 26, not 36, pressurized-water reactor fuel assemblies. The Final EIS includes a new "representative" commercial fuel for the purposes of calculating impacts of repository and transportation accidents. The representative fuel is based on a Hazard Index approach, which considers the relative hazard of all commercial spent nuclear fuel to be received at the repository. This fuel is younger and has higher burnup than the "typical" commercial fuels used in the Draft EIS. DOE has revised Section J.1.4.2 in the EIS to be consistent with the Appendix A numbers for "representative" commercial pressurized-water reactor fuel.

6 (2289)
Comment - EIS000594 / 0001
We're going to be consolidating the waste from 77 sites into one site. And I question whether or not those 77 sites are going to be radioactive free.

Are those 77 sites no longer going to be considered hazardous sites? Is all the radiation going to be cleaned up from those sites? That is going to take a really long time. I think it's a spin on information, and I don't think it's accurate.

Response
The Proposed Action would not provide any decontamination services to either utilities or DOE sites. The responsibility for actual cleanup of each of the 77 sites described in the EIS would remain with the facility owners. The Nuclear Regulatory Commission requires cleanup and remediation of commercial nuclear reactor sites after operations cease. DOE is actively remediating its nuclear sites to meet its own program requirements within schedule and funding constraints.

6 (5903)
Comment - EIS000815 / 0002
The major flaw in this DEIS is the failure to clearly distinguish between "Spent Nuclear Fuel," which contains large quantities of weapons and energy usable material, and "High Level Radioactive Waste," which does not. Most Americans are not aware of the difference, because the program initiated by Atomic Energy Commission Chairman Glenn Seaborg during the Administration of President John Kennedy to provide full and accurate information about nuclear technology to Americans was discontinued by the Energy Research and Development Administration and the Department of Energy.

Disposal of spent nuclear fuel would create a virtually permanent proliferation/diversion threat and deny any energy resource that could provide all of the electricity needs of the US for more than 10,000 years. This action should not be approved.

Disposal of high level radioactive waste would not create a proliferation threat nor deny an important energy resource. Moreover, its shipment to and disposal at Yucca Mountain would not result in significant danger to present or future populations. This action should be approved.

The DEIS fails to explain that spent fuel being considered for disposal at Yucca Mountain would contain enough plutonium for 100,000 nuclear weapons. This plutonium would become accessible for easy recovery after a few hundreds year decay of intensely radioactive fission products. Thus the proposed action for disposal of spent fuel would lead to a virtually permanent proliferation/diversion threat that could not be safeguarded.

The DEIS also fails to explain that materials in this spent fuel could be used to produce electricity needs for the U.S. for more than 10,000 years, without the pollutants that poison our atmosphere and greenhouse gasses that threaten catastrophic climatic changes.

Response
DOE agrees that spent nuclear fuel contains weapons-usable materials. In relation to the possibility of a proliferation or diversion threat following closure of the proposed repository, however, Congress, in the Nuclear

Waste Policy Act of 1982, mandated the development of deep geologic disposal for spent nuclear fuel and high-level radioactive waste to isolate the material from the accessible environment. DOE believes that placing the material an average of approximately 300 meters (1,000 feet) below the surface in a repository excavated from solid rock satisfies the intent of such isolation in relation to potential terrorist activity. To excavate to the repository level after closure would take a very large level of effort, with sophisticated excavation equipment, a large workforce, and significant expenditure of funds – all unlikely without being highly visible to authorities and the public. Therefore, such activity would be unlikely. Even if terrorists were able to penetrate to repository depth, the spent nuclear fuel and high-level radioactive waste would be in waste packages weighing between 32 and 82 metric tons (35 and 90 tons), each made of solid metal (stainless steel and Alloy-22) approximately 8 centimeters (3 inches) thick. Without the ventilation systems and emplacement equipment that DOE would use to handle waste packages remotely, terrorists would probably not survive the high temperatures and high radiation fields in the repository. Therefore, it is unlikely that terrorists could remove or significantly damage a waste package.

DOE also agrees that the significant quantity of fissionable material in spent nuclear fuel could be used as an energy source. However, for reuse in commercial nuclear reactors to generate electricity, the spent nuclear fuel would have to undergo chemical reprocessing. At present, the United States does not reprocess spent nuclear fuel for either nuclear power generation or nuclear explosive purposes. President Carter announced the policy in 1977 to defer such reprocessing indefinitely. On September 27, 1993, President Clinton announced to the United Nations that "the U.S. would seek to eliminate where possible the accumulation of stockpiles of highly enriched uranium or plutonium, and to explore means to limit stockpiling of plutonium from civil nuclear programs." He explained that the United States "does not encourage the use of civil plutonium and, accordingly, does not itself engage in plutonium reprocessing for either nuclear power or nuclear explosive purposes."

However, to protect future options, including recovery and reuse of the waste materials, Section 122 of the NWPA requires retrievability at a repository. Federal regulations (10 CFR Part 63) require the repository design to include the option of retrieval on a reasonable schedule for as long as 50 years after the start of waste emplacement. In accordance with these requirements, the operational plan for the proposed Yucca Mountain Repository includes a design and management approach that would isolate wastes from the public, and incorporates options to modify emplacement and retrieve the waste. This design would maintain the ability to retrieve emplaced materials for at least 100 years and possibly as long as 300 years in the event of a decision to retrieve the waste either to protect the public health and safety or the environment or to recover resources from spent nuclear fuel.

6 (6251)
Comment - EIS001972 / 0002
President Carter's Presidential Executive Order preventing the reprocessing of high-level radioactive nuclear waste should be rescinded. The premise for this Order is no longer valid.

The high-level radioactive nuclear waste is a very valuable resource, and with the future advance of technology, the option of reprocessing this material for the benefit of our society should remain open.

Yucca Mountain should be characterized as a "storage site," and not a "disposal site" for high-level radioactive nuclear waste.

With Yucca Mountain as a high-level radioactive nuclear waste "storage site," and in the future the reprocessing of this material, this would provide Nevada with business diversification, development of a technology center, and significant economic benefits.

Response
While materials disposed of in the repository could have the potential to be an economic resource, it has been a long-standing policy of the United States to promote international nonproliferation efforts by not reprocessing nuclear material. This policy, initiated by President Carter in 1977, called for deferral of commercial reprocessing in the United States and called on other nations not to proceed with reprocessing programs. In 1993, President Clinton reemphasized U.S. policy, stressing the need to avoid increasing the accumulation of material that has the potential for use in nuclear weapons. Our national security policy places a high priority on nonproliferation and makes it an integral element of relations with other countries.

The potential use of a permanent repository is critical to the U.S. nonproliferation policy. Section 122 of the NWPA requires retrievability at a high-level radioactive waste repository. Federal regulations at 10 CFR Part 63, *Disposal of High-Level Radioactive Wastes in a Proposed Geological Repository at Yucca Mountain, Nevada*, require DOE to design the repository to preserve the option of waste retrieval on a reasonable schedule for as long as 50 years after the start of waste emplacement. In accordance with these requirements, the operational plan for the proposed repository includes a design and management approach that isolates wastes from the public in the future while allowing flexibility to preserve options for modifying emplacement and retrieving the waste. This design would maintain the ability to retrieve emplaced materials for at least 100 years and possibly as long as 300 years in the event of a decision to retrieve the waste either to protect the public health and safety or the environment or to recover resources from spent nuclear fuel.

6 (6778)
Comment - 010141 / 0005
And our government, when we talk about money, they have no transportation. And in my report I did calculations that transport for the 77,000 metric tons, of which more than 7,000 is very arbitrary, this is DOD stuff, which is very hot and it's not pedigreed as are the rods from the nuclear power plants. And there will be more than 10,000 metric tons of this very disputable stuff.

Response
The EIS, in accordance with the NWPA evaluated the Proposed Action to construct, operate and monitor, and eventually close a repository at Yucca Mountain that would contain 70,000 metric tons of heavy metal (MTHM). The 70,000 MTHM would consist of 63,000 MTHM of commercial spent nuclear fuel and 7,000 MTHM of defense-related materials (10 percent of the total). The 7,000 MTHM of defense-related materials would consist of 2,333 MTHM of spent nuclear fuel, primarily from DOE production reactors, and 8,315 canisters of solidified high-level radioactive waste, primarily from the production of nuclear weapons materials. Appendix A of the EIS contains detailed descriptions of these materials, and Chapters 4 and 5 describe the short- and long-term impacts of repository disposal, respectively. Chapter 6 describes impacts related to the transportation of these materials to the proposed repository.

All waste accepted for disposal would meet the repository waste acceptance criteria as well as the packaging requirements. DOE would be responsible for ensuring that the waste is in a form that met approved acceptance and design criteria. Section A.1.1.3 of the EIS describes the steps to meet the disposal criteria. As part of the process, the Department would conduct inspections, audits, and quality assurance checks pursuant to a range of DOE Orders (see Section 11.3).

6 (6779)
Comment - 010141 / 0006
They play politics with it and our lives because they give it to DOE to service, but it is classified. And I have stated at every meeting I have ever been to that you cannot put classified waste in the mountain, and they know it.

Response
Appendix A of the EIS provides an inventory of all candidate materials for disposal in the repository. All waste accepted for disposal would meet the repository waste acceptance criteria and the packaging requirements, regardless of the classification of the material. These requirements would ensure that the repository could meet the long-term performance objectives.

6 (7923)
Comment - EIS000817 / 0039
In the first section you talk of vitrification and MOX [mixed-oxide] fuel use as if they are "done deals." They are not. Vitrification has problems and MOX hasn't even gone to Canada yet to be tested as far as I know. How can you predict anything about them at this stage?

Response
The more than 1,000 canisters of high-quality borosilicate glass produced to date at the high-level radioactive waste vitrification facilities at the West Valley Demonstration Project in New York and the Defense Waste Processing Facility at the Savannah River Site in South Carolina are evidence of the vitrification process as a proven

technology. Other documents (DIRS 103191-DOE 1994; DIRS 101729-DOE 1996; DIRS 103214-DOE 1996; DIRS 101816-DOE 1997) evaluated vitrification, so DOE has not included its process impacts in this EIS (see Section 1.5.3).

In the *Record of Decision for the Storage and Disposition of Weapons-Usable Fissile Materials Programmatic Environmental Impact Statement* (DIRS 103220-DOE 1997), DOE retained the option to use surplus plutonium as mixed-oxide fuel in Canadian uranium deuterium reactors, which would occur only in the event of a multilateral agreement between Russia, Canada, and the United States. Since the publication of the *Surplus Plutonium Disposition Draft Environmental Impact Statement* (DIRS 103222-DOE 1998), DOE determined that there is adequate commercial nuclear reactor capacity in the United States for disposition of the portion of U.S. surplus plutonium suitable to become mixed-oxide fuel. Therefore, DOE is no longer pursuing the Canadian uranium deuterium option. However, this option is still under consideration for the disposition of Russian surplus plutonium. To assist the United States, Russia, and Canada in considering this option, the three countries are conducting a joint experiment that will involve irradiating a small amount of mixed-oxide fuel fabricated from United States and Russian surplus weapons plutonium in a Canadian research reactor. This effort involved a one-time shipment of a small quantity of plutonium from the United States to Canada (65 *FR* 1620; January 11, 2000).

Mixed-oxide fuel has been used in light-water reactors since 1963 and is currently in more than 30 European reactors. Three European plants (two in France and one in Belgium) produce about 170 metric tons (190 tons) per year of mixed-oxide fuel for use in light-water reactors. In addition, mixed-oxide fuel plants under construction in Japan, Russia, and the United Kingdom will bring worldwide production of this fuel to more than 360 metric tons (400 tons) per year soon after 2000. DOE drew on this extensive experience to estimate potential impacts related to disposition of weapons-grade plutonium in U.S. light-water reactors. DOE evaluated these impacts in other documents (DIRS 103215-DOE 1996; DIRS 103222-DOE 1998; DIRS 103227-DOE 1999), and has not included them in this EIS (see Section 1.5.3).

6 (8481)
Comment - EIS001568 / 0003
The facility will not hold any decommissioning waste, whatsoever. That's a whole other problem, that's a shock to me. And I don't know how you're going to be planning on dealing with the huge volumes of materials that will be generated by that.

Response
This comment is correct that, in general, DOE does not plan to dispose of waste from decommissioning activities in a geologic repository. Candidate materials for a repository at Yucca Mountain are limited to spent nuclear fuel, high-level radioactive waste (as defined by the Nuclear Regulatory Commission at 10 CFR 60.2), and other wastes such as commercial Greater-than-Class-C and Special-Performance-Assessment-Required wastes if the Nuclear Regulatory Commission determines that they require permanent isolation.

In general, waste from decommissioning is not classified as radioactive waste, or is classified as low-level radioactive waste and disposed of in near-surface facilities. Some wastes associated with the decommissioning of commercial nuclear reactors could be Greater-Than-Class-C, and DOE has included them in the evaluation of Inventory Module 2 in Chapter 8 of the EIS. In addition, DOE has performed programmatic and site-specific evaluations of various options related to the disposition of its low-level waste, including the waste streams expected from facility decommissioning. Other DOE documents (such as DIRS 101802-DOE 1995 and DIRS 103209-DOE 1995) discuss impacts related to these activities.

6 (8996)
Comment - EIS001040 / 0027
What possible scientific reason would DOE allow mixtures of waste from civilian, research and defense sources?

Response
Spent nuclear fuels, whether generated from commercial applications or research or defense programs, have similar nuclear and physical characteristics and require long-term isolation from humans and the environment. As suggested by this comment, some of the spent nuclear fuel to be disposed of at the proposed repository has been generated as a result of civilian research. However, these materials are still the property of the U.S. Government.

6 (9442)
<u>Comment</u> - EIS001888 / 0130
DEIS Statement (pg. 2-38) - The DEIS assumes that, at the time of shipment, the spent nuclear fuel and high-level radioactive waste would be in a form that met approved acceptance and disposal criteria for the repository.

Clark County comment **-** The DEIS did not delineate how or who will be responsible for ensuring that the material to be disposed of is in approved form. NEPA [National Environmental Policy Act] Regulation: Sec. 1502.1 Purpose; Sec. 1502.16 Environmental consequences.

<u>Response</u>
Waste generators would be responsible to certify that their wastes meet the repository's waste acceptance criteria before acceptance by DOE and shipment to the proposed repository. DOE would be responsible for ensuring that the waste is in a form that meets approved acceptance and design criteria as specified in the repository's operating license. Section A.1.1.3 of the EIS describes the steps to meet the disposal criteria. As part of the process the Department would conduct inspections, audits, and quality assurance checks pursuant to a range of DOE Orders (see Section 11.3).

6 (10028)
<u>Comment</u> - EIS001930 / 0003
The EIS summary also specified that radioactive waste from medical and research labs would be deposited at the Yucca Mountain site, but it does not specifically identify the primary locations of these source points. It is likely that, due to the number of biomedical businesses located in San Diego that there are source points located in San Diego that would utilize regional state and local highways in San Diego County. Will truck routes from these sites be altered?

<u>Response</u>
The specific radioactive wastes from medical and research labs mentioned in this comment could be classified as Greater-Than-Class-C low-level wastes. Section A.2.5 of the EIS provides information about Greater-Than-Class-C wastes that could eventually require geologic disposal. These wastes are included in the EIS as part of Inventory Module 2. As stated in the introduction to Chapter 8 of the EIS, the disposal at Yucca Mountain of any wastes in excess of the 70,000 metric tons of heavy metal included in the Proposed Action would require legislative action by Congress unless a second repository was in operation. Section 8.4.1.1 addresses transportation impacts of the additional inventory modules. The majority of Greater-Than-Class-C wastes would be shipped from commercial nuclear utilities (65 percent by volume). Specific information regarding the various locations of other Greater-Than-Class-C wastes throughout the country is not readily available. The analysis assumed these wastes would be shipped from the 72 commercial sites using existing roadways or rail routes.

6 (10392)
<u>Comment</u> - EIS002192 / 0003
As you know, I will protest to my dying day and sue everybody until I die regarding the 10 percent DOD high-level waste and classified waste going into Yucca Mountain.

There is no mention of this DOD stuff in this report, and it is very remiss on that.

<u>Response</u>
The EIS, in accordance with the NWPA, evaluated the Proposed Action to construct, operate and monitor, and eventually close a repository at Yucca Mountain that would contain 70,000 metric tons of heavy metal (MTHM). The 70,000 MTHM would consist of 63,000 of commercial spent nuclear fuel and 7,000 MTHM of defense-related materials (10 percent of the total). The 7,000 MTHM of defense-related materials consist of 2,333 MTHM of spent nuclear fuel, primarily from DOE production reactors, and 8,315 canisters of solidified high-level radioactive waste, primarily from the production of nuclear weapons materials. Appendix A of the EIS contains detailed descriptions of these materials (Table A-20 specifically includes 65 MTHM of spent nuclear fuel from Navy applications), and Chapters 4 and 5 of the EIS describe the short- and long-term impacts of repository disposal, respectively. Chapter 6 describes impacts related to the transportation of these materials to the proposed repository.

In addition, Chapter 8 of the EIS evaluates the disposal in the repository of all commercial and DOE spent nuclear fuel and all high-level radioactive waste projected through 2046 (Module 1) as well as Greater-Than-Class-C low-level waste and defense-related Special-Performance-Assessment-Required low-level waste (Module 2) as a reasonably foreseeable future action. For this reason, Chapter 8 evaluates potential impacts for these actions as potential cumulative impacts.

In relation to classified materials in Yucca Mountain, Appendix A provides an inventory of all candidate materials for disposal in the repository. All waste accepted for disposal would meet the repository waste acceptance criteria as well as the packaging requirements regardless of the classification of the materials. These waste form and packaging requirements would ensure that long-term performance objectives can be met.

6 (10403)
Comment - EIS002192 / 0009
With DOE, I will absolutely not allow the secret stuff classified in my mountain, and how NRC [Nuclear Regulatory Commission] can even entertain anything to do the licensing, I do not know, but this will come up and this will go to court.

Response
All waste accepted for disposal would meet the repository waste acceptance criteria as well as the packaging requirements regardless of the classification of the materials. These waste form and packaging requirements would ensure that long-term performance objectives could be met.

6 (11316)
Comment- EIS002244 / 0002
We should quit calling it nuclear waste and start causing [calling] it nuclear poisons, or raw materials for weapons of mass destruction. When we examine the time frame of 50,000 years for nuclear waste disposal, we need to relate it to the life span of our own civilization of 5,000 years. Or a -- or let's see, a life of our civilization of 5,000 years, or 70 times our own life span.

When we examine the transportation issues of nuclear waste, we are now referring to them as the transportation of unstable raw materials or weapons of mass destruction. When we examine the issue of disposal of nuclear waste and structural integrity of containment for 50,000 years, the perceived risk under the new parameters become an unacceptable risk as well. This is the new assessment.

Response
Thank you for your input and participation in the EIS process. DOE has used terminology in the EIS consistent with the NWPA and standard industry usage.

With regard to perceived risk and the stigma of transporting and disposing of spent nuclear fuel and high-level radioactive waste, in the absence of a large accident or a series of smaller accidents, there is little reason to expect that perceptions about an operating repository would be likely to engender adverse effects. While stigmatization can be envisioned in some scenarios, it is not inevitable or quantifiable. DOE addressed the topic of perceived risk and stigma in this Final EIS (see Section 2.5.4 and Appendix N).

6 (11499)
Comment- EIS001337 / 0124
Page 1-3 Last sentence (continuing to Page 1-4) states, "...low-level radioactive wastes could require disposal in a monitored geologic repository." The DEIS does not appear to consider under what circumstances and in what quantities low-level waste would be disposed of at Yucca Mountain. The DEIS contains no assessment of the transportation requirements associated with transportation of low-level waste to the site.

Response
The low-level wastes the EIS considers for potential disposal at Yucca Mountain are those that would require eventual disposal in a geologic repository. Sections A.2.5 and A.2.6 of the EIS specifically identify these as Greater-Than-Class C low-level and Special-Performance-Assessment-Required wastes. The disposal of these

wastes is a reasonably foreseeable action identified in a public scoping comment for this EIS. Chapter 8 addresses these wastes as part of Inventory Module 2. Section 8.4 describes their transportation.

6 (11506)
Comment - EIS002137 / 0007
I believe this is a national issue. We talk about spent fuel rods. We talk about the fact that there's X number of commercial facilities. It's more than that. We have 115 submarines. We've got aircraft carriers. We've got reactors inside of universities. Hey, a lot of that's a national issue.

Response
This comment is correct in assessing that the disposal of spent nuclear fuel from commercial nuclear reactors, DOE and Navy spent nuclear fuel, and high-level radioactive waste is a national issue. Pursuant to the Nuclear Waste Policy Act of 1982, the EIS is part of the process required to resolve the issue. Appendix A provides a comprehensive description of the spent nuclear fuel and high-level radioactive waste that DOE would place in a geologic repository at Yucca Mountain.

6 (11938)
Comment - EIS001040 / 0014
Who holds title to the commercial and/or defense wastes?

Response
The owners of the nuclear powerplants that generate commercial spent nuclear fuel hold title to it. Defense spent nuclear fuel and high-level radioactive waste is owned by the United States. The New York State Energy Research and Development Authority owns commercial high-level radioactive waste at the West Valley Demonstration Project.

The NWPA specifically states that, "Delivery, and acceptance by the Secretary, of any high-level radioactive waste or spent fuel for a repository constructed under this subtitle shall constitute a transfer to the Secretary of title to such waste or spent fuel." Therefore, all wastes to be disposed of in Yucca Mountain would be the property of DOE on receipt. Prior to acceptance by the Secretary, the materials would have to be shown to meet the repository's waste acceptance criteria as specified by the Nuclear Regulatory Commission licensing conditions.

6.1 Inventories

6.1 (13)
Comment - 4 comments summarized
Several commenters criticized the method DOE used to calculate the metric tons of heavy metal equivalent for high-level radioactive waste. The commenters stated that the formula used (0.5 metric tons of heavy metal per canister of high-level waste) is a generalization and does not adequately reflect the actual content of heavy metal in the waste or the risks associated with the radioactive constituents. Another commenter acknowledged the Nuclear Waste Policy Act of 1982 limit of 70,000 metric tons of heavy metal but notes that by using the current calculation method, half of the high-level waste now in inventory would be precluded from being shipped to Yucca Mountain.

Response
Appendix A of the EIS describes the basis for several candidate methods for determining metric tons of heavy metal (MTHM) equivalence for high-level radioactive waste and explains that legislative action by Congress would be required to emplace more than the allotted 70,000 metric tons of heavy metal into the repository until a second repository was in operation. This comment is correct in that, depending on the equivalence methodology used, the total quantity of high-level radioactive waste that could be included in the 70,000 MTHM varies to a great degree. Since 1985, DOE has consistently used the "historical method" (0.5 MTHM per canister) as a planning basis, and this method is used in the EIS to determine the number of canisters of high-level radioactive waste included in the Proposed Action. There is a relatively small quantity of "commercial" high-level radioactive waste (West Valley Demonstration Project) that has been determined to have an MTHM equivalency per canister of 2.3, but the overall assumption of the 0.5 MTHM/canister remains valid since the vast majority of high-level radioactive waste canisters are "defense" waste, and constitute the basis for the 0.5 MTHM/canister assumption. Using this historical method,

less than half of the high-level radioactive waste inventory is included in the 70,000 MTHM. However, DOE has also evaluated the impacts of repository disposal of the entire inventory of high-level radioactive waste. Specifically, Chapter 8 provides cumulative impacts for the Proposed Action inventory (which includes less than half the high-level radioactive waste canisters utilizing the 0.5-MTHM-per-canister method) and for the Inventory Module 1 (which includes the balance of the high-level radioactive waste canisters). Using different equivalence methods would shift the proportion of the high-level radioactive waste canisters that could be disposed of between the Proposed Action and the Module 1 Inventory, but would not significantly change the cumulative impacts because spent nuclear fuel would dominate long-term repository performance results. Regardless of the equivalence method used, the EIS analyzes the range of potential impacts from disposal of the entire inventory of high-level radioactive waste such that the more conservative consequences are apparent.

The other equivalence methods, including the total radioactivity and the radiotoxicity methods, result in lower estimates of MTHM per canister. As such, these other methods result in the total inventory of high-level radioactive waste being accepted in the 70,000-MTHM Proposed Action repository. DOE is aware of these alternative methods and included them, for information, in Appendix A of the EIS.

6.1 (18)
Comment - 10 comments summarized
Several commenters believe that the Draft EIS spent nuclear fuel inventory and characteristics do not accurately represent the spent nuclear fuel DOE would receive. According to commenters, DOE has neglected a change in industry practice that has significant impacts on the fuel that will be discharged in the future. The change is that higher megawatt day per metric ton of heavy metal is becoming more common in industry operations. Therefore, the repository could receive younger fuel with a higher burnup ratio. Several commenters stated the need for DOE to update the inventory and characterization information. Commenters suggested the Department consider a range of different fuel ages in its analyses rather than examining only 25-year-old spent nuclear fuel because it is likely that younger, more radioactive fuel could be shipped to Yucca Mountain.

Response
DOE does not believe it has misrepresented the spent nuclear fuel characteristics in the Draft EIS. Section A.2.1.5 of the Final EIS provides the bases for selecting average pressurized-water reactor and boiling-water reactor fuel assemblies. These fuel assemblies replace the "typical" fuel assemblies in the Draft EIS and are based on more recent projections of commercial spent nuclear fuel shipments to the repository. Specifically, DOE selected the average assemblies to be representative of the average of the fuels the repository would receive and to provide a realistic estimate for analysis. The average commercial assemblies specified are used in the Final EIS for calculating the repository inventory and post-irradiation elemental distribution.

Rather than the average fuel, however, the Final EIS includes a new "representative" commercial fuel for purposes of calculating impacts of repository and transportation accidents. The representative fuel is based on a hazard index approach that considers the relative hazard for all commercial fuel to be received at the repository. This fuel, as the commenters note, is younger and has higher burnup than the typical commercial fuels used in the Draft EIS. Use of bounding fuel (maximum burnup and minimum cooling) is not appropriate for transportation accidents because transportation casks, to ensure compliance with thermal and direct radiation exposure limits, would only contain limited quantities of such fuel. Such loading requires use of casks that carry fewer spent nuclear fuel assemblies than the large-capacity casks assumed for the analyses in the EIS. In addition, the bounding fuel represents a very small fraction of the waste inventory. Thus, a reasonably foreseeable transportation accident that could involve shipment of this fuel would be much less severe than the maximum reasonably foreseeable accident in the EIS because of the lower quantity of the material available for release from an affected cask.

Similarly, for the maximum reasonably foreseeable repository accident, exclusive involvement of younger fuel would not be realistic because of the nature of the activities in the Waste Handling Building. Routine blending operations in the Waste Handling Building would include both younger and older spent nuclear fuel at any given time. Therefore, the Waste Handling Building would contain a mixture of younger, high-burnup and older, low-burnup fuel assemblies that would all be equally affected in the event of an accident. The Final EIS defines the parameters of the "representative" commercial fuel and the rationale for developing this new type for use in accident analysis.

6.1 (46)
Comment - 24 comments summarized
Commenters stated that the Proposed Action would be insufficient to dispose of the entire inventory of spent nuclear fuel and high-level radioactive waste projected to be generated in the foreseeable future. The EIS should provide an analysis of the impacts of continued storage or other management options for spent nuclear fuel and high-level radioactive waste that are not included in the Proposed Action. Commenters noted that by the time the repository would open in 2010, there would already be enough materials ready for transport to fill it completely. As a consequence, a number of commenters questioned how much waste is really going to be sent to Yucca Mountain, 70,000 or 105,000 metric tons of heavy metal. One commenter requested that the alternatives include the management of all spent nuclear fuel and high-level waste by evaluating larger repository capacities, describing the need for a second repository, and describing how the foreseeable inventory would be managed. Another commenter stated the EIS does not provide an evaluation of waste generated under renewed reactor licenses.

Response
Consistent with the Nuclear Waste Policy Act of 1982, the EIS evaluates impacts associated with the disposal of 70,000 metric tons of heavy metal (MTHM) of spent nuclear fuel and high-level radioactive waste as part of the Proposed Action. Appendix A identifies the total amount of spent nuclear fuel and high-level radioactive waste that DOE projects could be generated in the foreseeable future. The 105,000 MTHM mentioned in the EIS is the amount of spent nuclear fuel that existing commercial nuclear powerplants are assumed to generate through 2046. Chapter 8 evaluates potential consequences of using a repository at Yucca Mountain to dispose of the entire amount produced through 2046, for which DOE has ultimate responsibility. Appendix A describes the inventory and characteristics of the materials.

As noted above, Appendix A and Chapter 8 of the EIS address the potential for as much as 105,000 MTHM. This volume includes the assumption that all of the existing commercial nuclear reactors receive a 10-year extension to their operating licenses from the Nuclear Regulatory Commission, as well as the entire inventory of projected spent nuclear fuel and high-level radioactive waste from DOE and the Navy (see Section A.2). The EIS does not address any waste that could be generated by new commercial nuclear facilities because DOE cannot speculate about the long-term power generation mix commercial utilities may use in the future or about when or where new commercial nuclear reactors might go into operation. The NWPA states that the Nuclear Regulatory Commission decision to approve a DOE License Application shall prohibit the emplacement in the Yucca Mountain Repository of more than 70,000 MTHM of spent nuclear fuel and high-level radioactive waste until a second repository was in operation. In the case of a second repository, DOE would conduct appropriate environmental reviews at the time additional requirements or actions were identified.

6.1 (49)
Comment - 11 comments summarized
Commenters were concerned about the commitment that DOE has made to receive foreign research reactor fuels and other fuels from foreign commercial reactors. One commenter wanted to know specifically about materials from Japan.

Response
The Nuclear Non-Proliferation Act addresses the need to increase the effectiveness of international safeguards and controls on peaceful nuclear activities to prevent proliferation. To meet the goals of the Act, one of its provisions allows the United States, after complying with several statutory requirements, to accept foreign spent nuclear fuel regardless of its origin.

The Nuclear Non-Proliferation Act requires that the Secretary of Energy, Secretary of Defense, Arms Control and Disarmament Agency, and Nuclear Regulatory Commission agree that accepting such foreign fuel would meet the goal of the Act (that is, preventing proliferation). Under the Act, the Arms Control and Disarmament Agency would prepare a Nuclear Proliferation Assessment Statement to explain how U.S. acceptance would prevent proliferation. (Note: The Arms Control and Disarmament Agency is now part of the Department of State). The Act also establishes a process for Congress to approve the acceptance. In addition, the United States can accept limited quantities of foreign fuel without Congressional approval if the President determines that an emergency situation requires acceptance and is in the national interest, and notifies Congress with a detailed explanation and justification as soon as possible.

Consistent with the Nuclear Non-Proliferation Act and as described in the *Final EIS on a Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuels* (DIRS 101812-DOE 1996), the United States recently started accepting highly enriched uranium that it leased to other countries in the 1950s for use in research reactors. This action involves the acceptance of approximately 19.2 metric tons of heavy metal (21.2 tons) in spent nuclear fuel and 0.6 metric tons of heavy metal (0.7 ton) in target material from 4 countries over a 13-year period. The purpose of the action is to support the broad U.S. nuclear weapons nonproliferation policy calling for reduction and eventual elimination of highly enriched (weapons-grade) uranium. The analysis for this EIS included this material.

There is no effort by the Japanese government or Japanese utilities to ship spent nuclear fuel to the United States. The amount of foreign fuel, if any, that this country would accept under the Nuclear Non-Proliferation Act is limited to situations in which acceptance would be necessary to prevent proliferation of nuclear materials. While the United States can decide to accept foreign fuels under certain circumstances, other countries do not have an unfettered option to send their spent nuclear fuel to the United States.

Other than the foreign fuel noted above, this EIS does not anticipate or analyze the disposal of such fuel in the proposed repository. If in the future this country should consider acceptance and disposal of additional foreign fuel pursuant to the Nuclear Non-Proliferation Act, DOE would analyze it in accordance with its National Environmental Policy Act implementing regulations (10 CFR Part 1021).

6.1 (89)
Comment - 3 comments summarized
Commenters stated that vitrification of liquid high-level waste poses a serious technological challenge. Thus, DOE may opt to ship liquid high-level waste to the proposed repository.

Response
Vitrification is a process that solidifies and immobilizes high-level radioactive waste into a borosilicate glass or ceramic form inside stainless-steel canisters. Although vitrification does pose technical challenges, DOE has used this process for several years at the Savannah River Site in South Carolina and the West Valley Demonstration Project in New York. The waste acceptance criteria for the proposed repository, when finalized, would preclude the emplacement of liquid high-level radioactive waste. Therefore, DOE would not ship liquid wastes to the repository.

6.1 (116)
Comment - 9 comments summarized
Commenters stated that DOE must consider the volume and radioactivity of what is currently being proposed for disposal, and disposal packaging technology, including the "can-in-canister" and mixed oxide fuels for surplus plutonium pursuant to Nuclear Waste Policy Act. Commenters were also concerned that transportation impacts for these wastes had not been evaluated.

Response
Section A.2.4 of the EIS provides the inventory and characteristics of the surplus weapons-usable plutonium that is proposed for disposal at the repository. The Proposed Action includes the disposal of 50 metric tons (55 tons) of surplus plutonium. No more than 33 metric tons (36 tons) of this material would be converted to mixed-oxide fuel for use in commercial nuclear reactors. The other approximately 17 metric tons (19 tons) would be disposed of as an immobilized plutonium form in a can surrounded by glass in high-level radioactive waste canisters. The spent mixed-oxide fuels would be part of the 63,000 metric tons (69,000 tons) of commercial spent nuclear fuel in the Proposed Action and the immobilized plutonium would be part of the 7,000 metric tons (7,700 tons) of the DOE waste allocation.

DOE has included the 17 metric tons (19 tons) of surplus plutonium, which it would ship to Yucca Mountain in an immobilized waste form, in the shipment of 6,055 high-level radioactive waste canisters from the Savannah River Site (Section J.1.2.1.2 of the EIS). As listed in Table A-50 of the EIS, 670 of these canisters would contain immobilized plutonium. Chapter 6 and Appendix J evaluate the impacts associated with the transportation of these canisters for the Proposed Action. Chapters 4 and 5 address the short- and long-term impacts associated with disposal of these canisters, respectively.

In addition, the Proposed Action includes the impacts associated with transportation of the mixed-oxide fuel. DOE assumes that it would ship this fuel in one of the mixed-oxide shipping casks listed in Section J.1.2.1.1 of the EIS. The Department estimates that mixed-oxide fuel would make up less than 1 percent of the spent nuclear fuel in the Proposed Action.

6.1 (120)
Comment - 4 comments summarized
Commenters stated that the term "spent nuclear fuel" is misleading because it implies that the radioactivity is reduced or no longer present.

Response
The Nuclear Waste Policy Act of 1982 and the Glossary to the EIS (Chapter 14) define "spent nuclear fuel" as "fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing." DOE uses the term in the EIS to be consistent with the Act, not to be misleading. Appendix A describes the relevant characteristics of this material used to evaluate the environmental and safety impacts.

6.1 (474)
Comment - EIS000069 / 0006
We suggest that the total radioactivity of 14 billion curies in Nye County -- that is the burden that has been imposed upon Nye County as best we can tell from best available DOE information -- will continue to be a threat to the contamination of the environment and the water resources of this county and to the well-being and health and safety and the quality of life of this county well into the future, in perpetuity, forever.

Response
DOE recognizes that the risk of adverse health effects caused by exposure to ionizing radiation is of concern to many people. The Environmental Protection Agency's *Environmental Radiation Protection Standards for Yucca Mountain, Nevada* (40 CFR Part 197) require DOE to demonstrate a "reasonable expectation" that the "reasonably maximally exposed individual" not receive a radiation dose greater than 15 millirem per year for 10,000 years following disposal. DOE is committed to keeping radiation doses from Yucca Mountain-related activities below regulatory radiation exposure limits.

The updated analysis in the Final EIS projects that the Proposed Action would likely result in extremely small releases of radioactive contamination to the environment in the first 10,000 years after repository closure (more than 10,000 times less than the individual protection standard set by 40 CFR Part 197).

In addition to the 10,000-year compliance period, DOE has evaluated potential impacts for the period of geologic stability at the repository (that is, 1 million years). This evaluation was performed, in accordance with 40 CFR Part 197, to gain insight into the very long-term performance of the repository and thus provide information for the decisionmakers in making both design and licensing decisions. These results show a mean peak dose rate that is much lower than background levels (see Chapter 5 of the EIS for details).

6.1 (510)
Comment - EIS000061 / 0005
The disposal of these wastes, with a total radioactivity on the order of 14 billion curies, will most certainly render the environment of Nye County vulnerable to contamination well into the future and will pose a threat to the citizens in the shadow of the repository that will last, for all practical purposes, in perpetuity.

Response
DOE recognizes that the many people are concerned about the risk of adverse health effects caused by exposure to ionizing radiation. The Environmental Protection Agency regulations establishing *Public Health and Environmental Radiation Protection Standards for Yucca Mountain, Nevada* (40 CFR Part 197) require DOE to demonstrate that the "reasonably maximally exposed individual" would not receive a radiation dose greater than 15 millirem per year for 10,000 years following disposal. DOE is committed to keeping radiation doses from Yucca Mountain-related activities well below regulatory radiation exposure limits.

The updated analysis in the Final EIS projects that the Proposed Action would likely result in extremely small releases of radioactive contamination to the environment in the first 10,000 years after repository closure (more than 10,000 times less than the individual protection standard set by 40 CFR Part 197).

In addition to the 10,000-year compliance period, DOE has evaluated potential impacts for the period of geologic stability at the repository (that is, 1 million years). This evaluation was performed, in accordance with 40 CFR Part 197, to gain insight into the very long-term performance of the repository and thus provide information for the decisionmakers in making both design and licensing decisions. These results show a mean peak dose rate that is much lower than background levels (see Section 5.4.2 of the EIS for details).

6.1 (553)
Comment - EIS000075 / 0005
The issue of curies came up. How much is going into that repository? It's very difficult to tell given the EIS that came up, but it's very important.

Response
Section A.2.1.5.2 of the EIS lists the estimated number of curies in 50 separate isotopes in commercial spent nuclear fuel, each of which DOE used in the evaluation of impacts. DOE did not sum the individual radionuclides because a grand total could be misleading due to the wide variation of potential health effects among nuclides. For example, a curie of plutonium could cause a much greater effect to human health than a curie of cesium, which could cause a much greater effect than a curie of tritium. For that reason, the EIS estimates radiological dose to humans in rem or millirem.

6.1 (1040)
Comment - EIS000243 / 0002
I disagree with one of the statements made by a previous speaker, and that is that waste will be reduced in other places should the Yucca Mountain repository go ahead. From what I understand, waste may very well increase here in Idaho, because a decision to put a repository at Yucca Mountain, or perhaps any repository, but certainly for the purposes of this EIS one at Yucca Mountain, would then trigger the importation of more waste here to Idaho, and it may, in fact, increase nuclear activities which result in more waste in many of the places, whether it's commercial sites or military sites. So I think that's another impact that should be looked at. I would say that's about it for this comment.

Response
The potential selection of Yucca Mountain as the Nation's geologic repository would not cause the shipment of additional nuclear waste to Idaho. DOE currently maintains its inventory of spent nuclear fuel at a number of sites across the country. The EIS addresses shipment of DOE spent nuclear fuel to the repository from DOE sites in Idaho, South Carolina, Washington, and Colorado. The consolidation of fuel at these sites is part of separate DOE action evaluated in the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DIRS 101802-DOE 1995). With regard to increasing nuclear activities at commercial or military sites, the projected spent nuclear fuel inventories described in Section A.2.1.5.1 of the EIS include a conservative estimate of the potential inventory assuming commercial plant license extensions from the Energy Information Administration.

6.1 (1111)
Comment - EIS000250 / 0006
Another myth, and it pertains specifically to Idaho, is that this facility will solve our nuclear waste problems. However, the facility would take a portion of our waste and not our entire inventory. There is specific warning in the Governor's agreement that Governor Batt signed in 1995 with the nuclear Navy and Department of Energy that removes the limit on shipments of spent fuel to Idaho once this repository is in place.

I think you have to look at what is going on right now with the electro-metallurgical technology. The Department of Energy wants to use that to treat special batches of fuel. But I know the Department of Energy is also considering that treatment for other batches of fuel particularly Navy fuel, foreign reactor fuel, and perhaps other types of fuel. It's been talked about.

Response
DOE is aware of the terms and conditions of the Settlement Order and, if Yucca Mountain was recommended and approved as the site for the proposed repository, would make every effort to ensure that disposal operations began as scheduled and that waste currently in storage, to the amount limited by law, went to the repository. As noted by this comment, current restrictions prevent DOE from disposing of all spent nuclear fuel and high-level radioactive waste in the repository.

The Nuclear Waste Policy Act of 1982 limits a first repository to a volume of 70,000 metric tons of heavy metal (MTHM) until a second repository is in operation. The statutory limitations on the capacity of the first repository mean that not all DOE spent nuclear fuel and high-level radioactive waste could be placed in the first repository without Congressional action to amend or remove the capacity limit.

The EIS makes assumptions about a potential shipping queue for DOE spent nuclear fuel and high-level radioactive waste. These assumptions would maximize the potential impacts. The actual shipping queue for acceptance of the 7,000 MTHM of DOE materials would be finalized at a much later date, after a resolution of repository siting.

In September 2000, DOE selected electrometallurgical technology to treat sodium-bonded spent nuclear fuel from the Experimental Breeder Reactor-II at the Argonne National Laboratory - West near Idaho Falls, Idaho. In addition, the Department will develop alternative technologies that could provide cost savings or other benefits for similar fuel from the Fermi-1 Reactor. This decision followed the successful completion of a 3-year research and development demonstration project of this technology in August 1999. An independent review by the National Research Council found no technical barriers to the use of this technology to treat Experimental Breeder Reactor-II fuel. However, DOE will continue to investigate alternative treatment techniques while monitoring the results and costs of the electrometallurgical treatment of this fuel. Data evaluated through the National Environmental Policy Act process indicate DOE might be able to take advantage of the differences in the Fermi-1 and Experimental Breeder Reactor-II fuel to save money by treating the two fuel types with different techniques. If no alternative is more cost-effective for the Fermi-1 spent nuclear fuel, however, electrometallurgical treatment remains a viable option. DOE evaluated the inventory of high-level radioactive wastes resulting from the electrometallurgical treatment of sodium-bonded spent nuclear fuel in the Yucca Mountain EIS. Section A.2.3.2.2 of the EIS specifically discusses these waste types. DOE has no plans for the use of this technology, although potentially applicable to a wide variety of spent nuclear fuel types in addition to sodium-bonded fuels, for treatment of other DOE spent nuclear fuel, including naval or foreign reactor fuels.

6.1 (1176)
Comment - EIS000244 / 0001
At present there are about 150 separate sites in 41 states where used nuclear fuel and high-level radioactive waste is stored.

Response
As noted in Sections A.1.1 of the EIS, more than 99 percent of the commercial spent nuclear fuel would be from 72 sites in 33 states. Spent nuclear fuel from other facilities (for example, civilian research reactors) could be shipped directly to the repository. However, that inventory reflects less than 0.001 percent of the total spent nuclear fuel in the Proposed Action.

DOE maintains its inventory of spent nuclear fuel at five sites across the country. The Department's high-level radioactive waste is at the Savannah River Site in South Carolina, the Hanford Site in Washington, the West Valley Demonstration Project in New York, and the Idaho National Engineering and Environmental Laboratory. Prior to shipments of this material to a repository, all DOE spent nuclear fuel could be consolidated at four locations: the Savannah River Site in South Carolina, the Hanford Reservation in Washington, the Idaho National Engineering and Environmental Laboratory, and the Fort St. Vrain Dry Storage Facility in Colorado. Section A.2.2 of the EIS provides information on DOE spent nuclear fuel. The shipment of fuel to these sites is evaluated in *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DIRS 101802-DOE 1995). Based on the consolidation of DOE spent nuclear fuel already planned and the relatively small quantities of spent nuclear fuel at other locations, the EIS assumes all of the material would be at 72 commercial sites and 5 DOE sites across the country before shipping began.

6.1 (1206)
Comment - EIS000272 / 0003
We have sites in this state [Georgia] along with others that hold nuclear waste at the site of the utility companies' nuclear reactors. We have waste at the Savannah River site, right adjacent to us, over there on the river. The truth is that that waste right now is in its most volatile, unstable state, that is, its highest level of radioactivity. I'm not at all concerned by the fact that if and when the day comes that we transport this nuclear waste across the 40-plus states, depending on where the site is -- Having that happen 50 years from now, to me, is a far better alternative, when the radioactivity of that, the danger posed by these wastes in the event of an accident or emergency, is far lessened as the years go by. They are at a very unstable point now, sited at the nuclear reactors.

Response
This comment is correct in saying that, as spent nuclear fuel and high-level radioactive waste age, their radioactivity decreases. However, Congress, in passing the NWPA, established a schedule for the siting, construction, and operation of a repository that would provide adequate protection for the public and the environment. If the Yucca Mountain Site was recommended and approved, DOE would construct, operate and monitor, and eventually close a repository in accord with the provisions of this Act.

The comment is also correct in that delaying the shipment of these materials for 50 years could reduce radiation exposures to transportation workers (truck drivers and handlers) and the public living along the transportation routes. However, because of the generally higher population densities at the generator sites, delaying shipment to the proposed repository and allowing the material to accumulate could increase potential overall impacts to current and future generations of individuals living and working around the potential storage facilities at those sites. Section 7.2.1.7.3 of the EIS (Table 7-6) contains information on the effects of delayed shipment indicating that most short-term impacts from the continued storage of spent nuclear fuel and high-level radioactive waste (15 latent cancer fatalities) would result from exposure to noninvolved workers working near the storage facilities during the first 100 years of storage. Implementation of the Proposed Action would avoid much of this exposure. Under a delayed shipping scenario, such exposures would be additive to the somewhat reduced exposures to workers and the public resulting from the later transportation of spent nuclear fuel and high-level radioactive waste to the repository. Thus, a significant reduction in collective impacts under a delayed shipping scenario would be unlikely.

6.1 (1221)
Comment - EIS000296 / 0007
Absolutely no utility that increases the danger of high-level nuclear waste that they produce should be a part of the program, anyway. In that I'm talking specifically about Duke Energy and about Virginia Power because they have a very ill-conceived and dangerous plan to use -- at the taxpayer's expense, of course -- the weapons-grade plutonium at the power plants McGuire I and II in North Carolina, Catawba I and II in South Carolina and Virginia in Louisa County, North Anna I and II. And so no utility that takes on additional dangers in either the actual hazard or the amount of the waste should be a part of this program at all.

Response
DOE evaluated the environmental impacts associated with using mixed-oxide fuels in commercial nuclear reactors in the *Surplus Plutonium Disposition Final Environmental Impact Statement* (DIRS 118979-DOE 1999). This is a separate action from the Proposed Action evaluated in the Repository EIS, which focuses on the environmental impacts associated with construction, operation and monitoring, and eventual closure of a repository for disposal of spent nuclear fuel and high-level radioactive waste. In accordance with the Nuclear Waste Policy Act of 1982 and the *Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste* (10 CFR Part 961), DOE must accept (for disposal in a repository) all spent nuclear fuel from commercial utilities that have contributed to the Nuclear Waste Fund. Section 1.5.3 of the EIS discusses and lists other environmental documents that evaluate proposals and form a basis for decisions related to a geologic disposal program, including the Surplus Plutonium Disposition EIS. Appendix A of the EIS provides additional information about the inventory, characteristics, and sources of all materials that are candidates for disposal at Yucca Mountain, including surplus weapons-usable plutonium (see Section A.2.4).

6.1 (1317)

<u>Comment</u> - EIS000338 / 0001

The Department's concern is the storage and loading of high level wastes, particularly surplus weapons-usable plutonium, from Los Alamos for disposal at the proposed Yucca Mountain site (Volume I, p. 1-7; Volume II p. A-47). There is no information within the DEIS to indicate how Los Alamos will transfer such high-level radioactive material into the proper packaging (shipping casks). Specifically, the DEIS does not address what the potential contribution this activity at Los Alamos will be to radionuclide emissions subject to 40 CFR Part 61, Subpart H. Subpart H sets a facility-wide cap of ten millirems per year on the dose of radiation to which any member of the public might be exposed from air emissions. The DEIS should address to what extent a connected action of construction of facilities for waste packaging and loading at Los Alamos is necessary, and what the air quality impacts from packaging such wastes might be.

<u>Response</u>

The EIS evaluates impacts associated with the shipment of immobilized plutonium and spent mixed-oxide fuel. The analysis assumed that DOE would ship immobilized plutonium from the Defense Waste Processing Facility at the Savannah River Site, and the mixed-oxide fuel from the commercial utility that used the fuel in its reactor. The *Surplus Plutonium Disposition Final Environmental Impact Statement* (DIRS 118979-DOE 1999) addresses the transportation of plutonium from its current location to the Savannah River Site and the impacts from its subsequent processing.

Section J.1.3.1.2 of the EIS describes the potential radiological impacts of DOE spent nuclear fuel and high-level radioactive waste loading operations.

6.1 (1549)

<u>Comment</u> - EIS000357 / 0008

Page 1-6. 1.2.2.2. "Additional small quantities remain at other locations." What is going to be done with these quantities? Will they be dealt with under this planned action?

<u>Response</u>

Appendix A of the EIS addresses the complete inventory of DOE spent nuclear fuel. DOE maintains its inventory at a number of sites across the country. Before shipping this material to the proposed repository, the Department would consolidate all its spent nuclear fuel at four locations–the Savannah River Site in South Carolina, the Hanford Site in Washington, the Idaho National Engineering and Environmental Laboratory, and the Fort St. Vrain dry storage facility in Colorado. The *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DIRS 101802-DOE 1995) evaluates the shipment of this fuel.

6.1 (1550)

<u>Comment</u> - EIS000357 / 0009

Page 1-7. 1.2.4. Will the plutonium at the Pantex Plant, Rocky Flats Environmental Technology Site, Los Alamos and Lawrence Livermore National Laboratories be treated by this proposed action? If so, why are these not included in the maps, transportation routes, and analysis?

<u>Response</u>

The surplus plutonium DOE would dispose of under the Proposed Action [50 metric tons (55 tons)] would come to the repository in two forms. Plutonium that had been converted to mixed-oxide fuel would be shipped in the form of spent nuclear fuel from its associated commercial utility. Immobilized plutonium would be shipped in high-level radioactive waste canisters from the Savannah River Site.

The EIS evaluates impacts associated with the shipment of immobilized plutonium and spent mixed-oxide fuel. The analysis assumed that DOE would ship immobilized plutonium from the Defense Waste Processing Facility at the Savannah River Site, and the mixed-oxide fuel from the commercial utility that used the fuel in its reactor. The *Surplus Plutonium Disposition Final Environmental Impact Statement* (DIRS 118979-DOE 1999) addresses the transportation of plutonium from its current location to the Savannah River Site and the impacts from its subsequent processing.

The transportation analyses in Chapter 6 of the EIS include the shipment of these two forms to the Yucca Mountain Repository. DOE has clarified the introduction to Chapter 6.

6.1 (1551)
Comment - EIS000357 / 0010
Page 1-11. 1.3.2.2. The weight of inventory of radioactive heavy metal is specified as 70,000 MTHM. But how does this convert to volume?

Response
Appendix A of the Draft EIS provides information that attempts to correlate the 70,000 MTHM (metric tons of heavy metal) of materials into volume. For the 63,000 MTHM of commercial spent nuclear fuel, A.2.1.5.1 reports the volume to be approximately 29,000 cubic meters (38,000 cubic yards). For the entire inventory of DOE spent nuclear fuel (2,500 MTHM, of which 2,333 MTHM is included in the Proposed Action), the table in Section A.2.2.3 reports the total volume to be approximately 1,900 cubic meters (2,500 cubic yards). For high-level radioactive waste, there would be two types of canisters [3 meters (9.8 feet) long and 4.5 meters (15 feet) long]. The estimated volume of high-level radioactive waste in the Proposed Action would be 6,600 cubic meters (8,600 cubic yards). Therefore, the total volume of materials to be emplaced during the Proposed Action would be approximately 37,500 cubic meters (49,000 cubic yards).

The value of MTHM for DOE and commercial spent nuclear fuel is based on the actual amount of heavy metals (uranium, plutonium, and thorium) in the spent nuclear fuel when it was received at the repository. For high-level radioactive waste, however, very little of these heavy metals would actually be in each canister. The 0.5 MTHM per canister is a convention applied to the high-level radioactive waste canisters only for accounting purposes. It does not apply to the accumulation of MTHM for spent nuclear fuel.

6.1 (1552)
Comment - EIS000357 / 0011
Page 1-12. Section 1.3.2.2. Do we assume that the 105,000 metric tons of heavy metal of waste from operating nuclear power plants through the year 2046 would equal 210,000 canisters of waste? Why is this not specified when the 2,500 metric tons of heavy metal of DOE spent nuclear fuel translates to 22,280 canisters, far more than the 0.5 metric tons of heavy metal proposed per canister?

Response
There is a distinct difference in the way that the EIS accounts for and describes spent nuclear fuel and high-level radioactive waste. The EIS analysis based the value of metric tons of heavy metal (MTHM) for DOE and commercial spent nuclear fuel on the actual amount of heavy metals (uranium, plutonium, and thorium) in the spent nuclear fuel the repository would receive. The total projected amount is 105,000 MTHM of commercial spent nuclear fuel (which would be in the form of approximately 360,000 assemblies either uncanistered or canistered, depending on the packaging scenario) and 2,500 MTHM of DOE spent nuclear fuel in standard DOE fuel canisters. The total projected amount of high-level radioactive waste from Section A.2.3.5.1 of the EIS is 22,280 canisters. This waste would generally be in the form of borosilicate glass in stainless-steel canisters, and would actually contain very little heavy metal. The 0.5 MTHM per canister is a convention applied to the high-level radioactive waste canisters for accounting purposes. It does not apply to the accumulation of metric tons of heavy metal for spent nuclear fuel. Appendix A provides more information on this topic.

6.1 (1727)
Comment - EIS000291 / 0002
Just as an example, several times in the opening remarks there was the comment that there are 77 storage sites now, and not a mention was made that immediately upon leaving one of those storage sites there would be one more, on the truck. And there wasn't any mention that once it arrives wherever it's going, that there will be one more and that for many, many years, for decades, there will be not 77 storage sites in the country but many more. There will be temporary storage sites on the roads and, of course, the repository will be an additional one.

Response
DOE identified the number and locations of 77 generator sites as a basis for determining the potential impacts associated with transportation of the waste material to the proposed repository and for evaluation of the No-Action

Alternative. As a consequence, DOE believes that waste in transit is thoroughly analyzed in the EIS. In addition, the EIS discusses intermodal transfer stations, and alternative transportation modes. Adding material in transit to the list of 77 sites would be misleading.

6.1 (1955)
Comment - EIS000483 / 0001
The Yucca Mountain Environmental Impact Statement (YM-EIS) should include the option of emplacement of depleted uranium (DU) in the repository as a useful material and/or as a waste.

The United States has an inventory of ~500,000 tons of radioactive DU, which is a secondary product from the production of (1) commercial spent nuclear fuel, (2) navy and research reactor fuel, and (3) nuclear weapons. Much of this material may ultimately become a waste. Geological disposal is the preferred option for disposing of large quantities of DU. DU is not included in the draft YM-EIS (pg 8-60). The basis for this recommendation to include DU in the YM-EIS is as follows:

1. U.S. Nuclear Regulatory Commission (NRC) actions clearly indicate that geological disposal of DU is the preferred option for disposal of DU.

2. The "Final Programmatic Environmental Impact Statement (PEIS) For Alternative Strategies for the Long-Term Management and Use of Depleted Uranium Hexafluoride" raises serious questions about the viability of non-repository DU disposal options.

3. Disposal of DU in a repository assures a consistent waste management philosophy.

Response
DOE currently stores about 700,000 metric tons (770,000 tons) of stable depleted uranium in the form of uranium hexafluoride at three locations in Tennessee and Kentucky. The EIS (in Sections 4.1.15.3, 4.1.15.5.4, and 4.1.15.5.5) recognizes the potential benefits of using depleted uranium as a shipping cask material. While depleted uranium could be used in the manufacture of waste packages, the amount of this material far exceeds the quantities that could be used in such packages. However, disposal of depleted uranium as a waste in the Yucca Mountain Repository is not authorized by the Nuclear Waste Policy Act of 1982, which limits disposal to spent nuclear fuel and high-level radioactive waste. Thus, depleted uranium does not meet the criteria for materials that DOE could dispose of in a repository, and is not included in the Proposed Action as an acceptable waste form.

Nuclear Regulatory Commission regulations (10 CFR Part 61) indicate that low-level radioactive waste, such as depleted uranium, can be disposed of in near-surface trenches, which is a sufficient and far less costly method than a geologic repository. This disposal option is considered in the *Final Programmatic Environmental Impact Statement for Alternative Strategies for the Long-term Management and Use of Depleted Uranium Hexafluoride* (DIRS 152493-DOE 1999). DOE did not choose this option, however, as the preferred option because of the preference to undertake some future productive use of depleted uranium. DOE did consider the use of depleted uranium for repository components. Such use was not deemed practical.

The DOE plan for the conversion of depleted uranium hexafluoride advocates the development of a strategy for future management of depleted uranium. The strategy entails conversion of uranium hexafluoride to an environmentally safer form (either an oxide or metal or both), to enable its constructive use. DOE will continue to keep its options open regarding potential beneficial uses of this material.

6.1 (2866)
Comment - EIS001099 / 0001
The Tennessee Department of Environment and Conservation, DOE Oversight Division (TDEC/DOE-O).

At present, there are no categorized high level wastes on the Oak Ridge Reservation (ORR). There is, however, a potential for categorizing part of ORR's Special Case wastes (SCW) as High-level waste. Both the preferred alternative and the no-action alternative are therefore, of importance to the State of Tennessee.

The State recommends contingencies for disposal of any newly categorized ‘high level’ waste be included in the EIS. In the no action alternative, DOE should evaluate and discuss funds for management and control of in situ releases from these wastes.

Two terms have been used in Environmental Impact Statements prepared by DOE since the Waste Management document was issued. They are “Special Case” wastes (SCW) and Special-Performance-Assessment-Required (SPAR) wastes. SPAR wastes are mentioned in the documents on WIPP [Waste Isolation Pilot Plant] and Yucca Mountain. SPAR waste is one of the categories of SCW. Nine categories of special wastes are listed in a status report of SCW dated April 29,1997:

1. Non-certifiable defense transuranic waste
2. Non-defense transuranic waste
3. Greater than class C waste (GTCC) which was originally Special-Performance-Assessment-Required waste
4. Performance Assessment Limited (PAL) waste originally also SPAR waste
5. Fuel and fuel-debris
6. Uncharacterized waste
7. Excess nuclear material
8. Radiation sources
9. DOE-titled waste or material held by Nuclear Regulatory Commission (NRC) licensees.

Since characterization of the entire class of Special Case wastes has not been completed, the inventory of each category is uncertain, especially in view of inaccuracies in DOE’s past inventory estimates. The amount of Special Case waste that will fall into the Special-Performance-Assessment-Required waste category is not known. DOE should reevaluate Categories 1 and 2 for disposal at WIPP and/or explain why the waste would not meet the WIPP WAC [waste acceptance criteria] or could not be cost effectively disposed at WIPP. DOE-Oak Ridge Operations is currently preparing and EIS to construct a TRU [transuranic waste] Processing Facility at ORNL [Oak Ridge National Laboratory]. Categories 1 and 2 of the SCW could be handled by the Oak Ridge treatment facilities and the waste disposed at WIPP. Categories 1, 2, 3 & 4 at present do not have disposal options. The State of Tennessee’s position is that DOE should carefully inventory, characterize, verify current safe storage, and identify disposition options for those category 1, 2, 3 & 4 wastes unsuitable for shallow land burial. Categories 5 through 9 should be assessed in detail for potential classification as High-level waste (Radioactive Management DOE Order 435.1) or other categories suitable for disposal options.

Planned disposition of several categories of waste has been documented by DOE. These documents have assumed the absence of certain waste categories at some sites. The preferred (and selected) alternatives contained in these documents do not include contingencies for later discoveries of additional inventory from these sites.

The Records of Decision on [the WIPP project] are already in place. They direct the disposition of some of the ORR wastes. Disposition of Special Case wastes and non-defense wastes by choice, were not considered in those Records of Decision. As a host State to those unidentified, uncharacterized and unknown amounts of wastes, Tennessee requests that the EIS address the above comments and include options that respond to ORR problems in a timely manner.

Response

The Nuclear Waste Policy Act of 1982 defines high-level radioactive waste as, “(A) the highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations; and (B) other highly radioactive material that the Commission, consistent with existing law, determines by rule requires permanent isolation.”

As stated in this comment, there is currently no high-level radioactive waste on the Oak Ridge Reservation. Therefore, DOE has identified no high-level radioactive waste for shipment from Oak Ridge to the proposed repository. The EIS did, however, identify Special-Performance-Assessment-Required low-level wastes in Inventory Module 2 that DOE could ship from Oak Ridge. Section 8.4.1.1 of the EIS addresses the impacts of such shipments. Section 8.2 addresses the impacts of the disposal of those wastes at the repository. As discussed in

Section 7.3, DOE did not conduct a specific No-Action analysis for Inventory Module 2, because DOE believes that the Module 1 No-Action analysis provides a reasonable estimate of the impacts from Module 2.

Because this is not a programmatic waste management EIS and is specific to the disposal of spent nuclear fuel and high-level radioactive wastes, DOE has not evaluated unidentified, uncharacterized, and unknown amounts of waste, as requested by this comment, and believes attempts to estimate quantities and resultant impacts from disposal or continued storage of such materials at this time would be too speculative to provide meaningful information to the decisionmaking process.

6.1 (4249)
Comment - EIS001160 / 0063
Page 1-4, Section 1.2.1, Generation of Spent Nuclear Fuel and High-Level Radioactive Waste, Paragraph 5, Line #2 states "All of these reactors have been shut down for several years." This statement is not entirely correct. Most of these reactors have been shut down for several years, however the production of plutonium for weapons research and other research purposes have continued. In any case, it would be useful to reference how many years the reactors have been shut down, and what storage problems and considerations were observed, perhaps in the appendices.

Response
The cited paragraph in the EIS refers to reactors used to produce weapons-grade materials, such as plutonium. DOE has shut down all reactor fuel cycles used for this purpose. The repository waste of concern from the fuel-cycle operations is defense high-level radioactive waste. Appendix A of the EIS discusses the specific inventory of such wastes, including the high-level radioactive waste to which the cited paragraph refers. In addition, Appendix A discusses the anticipated spent nuclear fuel inventory from currently operating reactors, commercial and DOE.

Regarding the suggestion to include reactor shutdown times and other information, DOE has not added this material because it would add no discriminating information for decisionmakers.

6.1 (4253)
Comment - EIS001160 / 0067
Page 1-7, Section 1.2.3, High-Level Radioactive Waste, Paragraph 2, line(s) 3-4. The text here states, "Treatment ordinarily includes separation of the waste into high activity and low activity fractions, followed by vitrification of the high activity fraction." High and low fractions are not clearly defined. It would be advantageous to list the criteria for high and low fractions in the appendices not only for storage limitations but also for transportation criteria. Furthermore, the type of canister the vitrified high fraction material is stored in should also be listed both for storage and transportation purposes as this material may present different packaging demands than fuel assemblies.

Response
Section 1.2.3 of the EIS accurately describes an ordinary vitrification process. The separation of high- and low-activity fractions is a result of a typical vitrification pretreatment for high-level radioactive waste. Pretreatment ordinarily concentrates the radioactivity from the waste, resulting in a reduction of the amount of high-level radioactive waste. The low-activity fraction from the pretreatment process does not meet the definition of high-level radioactive waste (10 CFR 60.2). The Waste Incidental to Reprocessing determination process is used to determine that the low-activity fraction does not need to be managed as high-level radioactive waste. Three criteria must be satisfied for this waste to be managed as low-level radioactive waste and, therefore, suitable for near-surface disposal without vitrification. The EIS Glossary (Chapter 14) contains definitions of high- and low-level radioactive waste. The inventory for shipment to and disposal at the proposed repository includes only the vitrified high-level radioactive waste.

6.1 (4707)
Comment - EIS001230 / 0002
Metric Tons of Heavy Metal

The Nuclear Waste Policy Act was enacted in 1982 for the purpose of developing a geologic repository to protect the population and the environment from the hazards of radioactive waste. The Nuclear Waste Policy Act limited the amount of SNF [spent nuclear fuel] and HLW [high level waste] to 70,000 metric tons of heavy metal (MTHM) that could be placed in the Nation's first geologic repository until a second repository could become operational.(1) The limitation was meant to provide "regional equity" among potential repository sites.

We understand that the material that could eventually go to the geologic repository includes civilian SNF (from commercial nuclear power plants), DOE SNF (from DOE production reactors, naval reactors, and experimental reactors), and DOE HLW(2) (primarily waste that resulted from the chemical extraction of weapons-usable materials from defense SNF). In order to project the impacts that would result from the geologic repository, DOE must determine the quantities and characteristics of each of the three materials that would be disposed.

DOE determined that 90 percent (63,000 MTHM) of the 70,000 MTHM (allowed into the geologic repository) would be allocated for commercial SNF and the remaining 10 percent (7,000 MTHM) for DOE SNF and HLW. It has further been determined that 33 percent of the DOE's allotment (2,334 MTHM) would be allocated for DOE-owned SNF and 67 percent (4,666 MTHM) for HLW.

Calculation of the MTHM of SNF is relatively straightforward, based on the actual heavy metal content of the SNF. Calculation of the equivalent MTHM for HLW (which was not specified by Congress) is somewhat more complicated, however, and will affect the quantity of waste that can be accepted into the geologic repository. Both commercial SNF and DOE HLW contain the radioactive elements that are formed in a nuclear reactor. However, DOE SNF was generally retained in the reactor for a much shorter time than is the case for a comparable amount of commercial SNF. Because the amount of waste that is produced in SNF is dependent upon the length of time it stays in the reactor, much less radioactive waste material was produced per metric ton of DOE SNF compared to waste produced per metric ton of commercial SNF. In addition, DOE's HLW consists only of the radioactive waste elements, which were separated from DOE SNF using a technology known as reprocessing, and no longer includes the heavy metals. Because of these differences, we recommend that the most consistent and comparable measure for comparing HLW with SNF is in terms of an "equivalent MTHM" or the quantity of HLW that would produce the same radioactivity or radiotoxicity as a metric ton of SNF.

In the Draft EIS, impacts are evaluated using a method for calculating MTHM equivalence based on historical projections of radioactivity in HLW. Those historical projections are no longer valid, however, because the radioactivity levels in HLW now being produced are significantly lower. If the historical projections method is applied, the level of radioactivity that would result from each MTHM of HLW disposed in the geologic repository would be significantly lower than the level of radioactivity that would result from each MTHM of commercial SNF disposed. We believe there is no scientific basis for this inequitable and overly restrictive approach. In addition, the geologic repository capacity restriction of 4,666 MTHM for HLW will be inadequate to accommodate all of the HLW under DOE's purview if DOE uses the historical projections method.

This dilemma is recognized in Appendix A of the Draft EIS through the discussion of the methods for calculating MTHM. One method, the Total Radioactivity Method, would establish equivalence based on a comparison of the radioactivity inventory (curies) of HLW to the average curies found in a metric ton of commercial SNF. The second, the Radiotoxicity Method, would involve calculation of the "relative radiotoxicity" (based on the inventory of specific radionuclides present and their respective regulatory release limits). Using either of these two methods for calculating the MTHM equivalency for HLW would allow a more equitable allocation of storage space in the geologic repository between the commercial and DOE materials. Both of these alternative methods would allow DOE to dispose of all of its HLW at the geologic repository, without exceeding maximum limits established by Congress.

Accordingly, the INEEL CAB [Idaho National Engineering and Environmental Laboratory Citizens Advisory Board] recommends that DOE adopt either the total radioactivity method or the radiotoxicity method in this EIS as a more equitable and scientifically justifiable estimate of equivalent MTHM for the inventory of HLW. This approach would pose no additional risk to human health and the environment (above the risks evaluated in the Draft EIS). It would also reduce risks and costs associated with managing those risks at the sites where the undisposed HLW would remain, pending development of another repository at some undetermined point in the future.

Under its current design, the geologic repository will accept no waste with hazardous constituents as defined by the Resource Conservation and Recovery Act (RCRA). However, the DOE-owned HLW that is currently at INEEL contains listed hazardous constituents and is classified as "RCRA hazardous.(3) In order for the HLW presently at INEEL to be disposed at the proposed geologic repository, various additional activities would have to occur. The INEEL CAB is concerned that the Draft EIS does not address what actions would be required to dispose of HLW that contains listed hazardous constituents, the impacts of those actions, nor the impacts of disposing those wastes at the proposed geologic repository. We note that these wastes constitute a significant portion of the HLW under DOE's control, and that DOE is responsible for permanent disposal of the entire inventory of HLW under the Nuclear Waste Policy Act.

Under the current regulatory framework, two options exist that could allow eventual disposal of these hazardous wastes at the proposed geologic repository at some point in the future. DOE could decide to seek a permit for the geologic repository as a disposal facility under RCRA. Such a permit would require approval by the State of Nevada (as the State has regulatory authority under RCRA within that state). Alternatively, DOE could seek to have the HLW with hazardous constituents "delisted" (following treatment) to allow their disposal in the geologic repository. That strategy would require documentation of the treatment methodology and extensive coordination among the states of Nevada and Idaho and two regions of the U.S. Environmental Protection Agency. Both strategies could prove difficult to implement. Nevertheless, the INEEL CAB recommends that DOE evaluate the Proposed Action in the Final EIS based on an assumption that all of the HLW with hazardous constituents will eventually go to the geologic repository for permanent disposal. This approach would allow development of environmental documentation that could support follow-on decision-making should DOE eventually overcome the challenges to acceptance of hazardous constituents at the geologic repository.

1. The Draft EIS explains that: 1) quantities of SNF are traditionally expressed in terms of metric tons of heavy metal, not including other materials such as cladding and structural materials, 2) a metric ton is 1,000 kilograms

2. or 2,200 pounds, and 3) uranium and plutonium are called heavy metals because they are extremely dense.

3. Including HLW from West Valley.

4. HLW currently at Savannah River Site does not contain hazardous constituents and is believed to be acceptable at the geologic repository.

Response
In relation to the calculation of metric tons of heavy metal (MTHM), Appendix A of the EIS describes the basis for several candidate methods for determining metric tons of heavy metal repository equivalence for high-level radioactive waste and explains that Congress would need to take legislative action before DOE could emplace more than the allotted 70,000 metric tons of heavy metal in the proposed repository. This comment is correct in that, depending on the equivalence methodology, the total quantity of high-level radioactive waste in the 70,000-MTHM repository could vary to a great degree. Since 1985, DOE has used the "historical method" (0.5 MTHM per canister) as a planning basis, and used this method in the EIS to determine the number of canisters of high-level radioactive waste in the repository. Using this method, the Proposed Action (70,000-MTHM repository) would contain less than half of the high-level radioactive waste inventory. However, DOE has evaluated the consequences of repository disposal of the entire inventory of high-level radioactive waste. Specifically, Chapter 8 of the EIS discusses cumulative impacts for the Proposed Action inventory (which includes less than half the high-level radioactive waste canisters under the 0.5- MTHM-per-canister method) and for a Module 1 inventory (which includes the balance of the high-level radioactive waste canisters). Using different equivalence methods would shift the proportion of high-level radioactive waste canisters for disposal between the Proposed Action and the Module 1 Inventory, but would not significantly change the cumulative impacts because spent nuclear fuel would dominate long-term repository performance results. Regardless of the equivalence method, the EIS analyzes impacts from the disposal of the entire inventory of high-level radioactive waste such that conservative consequences are apparent.

While the EIS evaluates the environmental consequences of the disposal of more than 70,000 MTHM repository of spent nuclear fuel and high-level radioactive waste (Module 1 inventory), the ultimate limits on disposal quantities belong to Congress.

The other equivalence methods, including the total radioactivity and radiotoxicity methods, result in lower estimates of metric tons of heavy metal per canister. As such, these methods would result in the acceptance of the total inventory of high-level radioactive waste in the 70,000-MTHM repository. Appendix A of the EIS includes these methods for information purposes.

In response to the comment's concern about hazardous waste, current planning calls for a Yucca Mountain Repository not to accept wastes either listed or characteristic hazardous at the time of disposal, as defined in 40 CFR Part 261.

DOE is aware that the high-level radioactive waste at both the Idaho National Engineering and Environmental Laboratory and the Hanford Site contain listed hazardous wastes. The Environmental Protection Agency and the States of Nevada, Washington, and Idaho would have to "delist" such wastes before DOE could dispose of them at a Yucca Mountain Repository because there are no plans to permit the repository as a Resource Conservation and Recovery Act disposal facility. DOE would have to petition the Environmental Protection Agency to delist the waste. Petitions to the states under state law or regulations might also be required.

DOE high-level radioactive waste could exhibit characteristics of hazardous waste (ignitability, reactivity, corrosivity, and toxicity) prior to treatment. The treated (vitrified) waste would not exhibit such characteristics. Characteristic hazardous wastes do not require a petition and rulemaking by the Environmental Protection Agency or states to exit the hazardous waste system.

Both listed and characteristic hazardous wastes would have to meet applicable *Land Disposal Restrictions Treatment Standards* (40 CFR Part 268) prior to disposal at a Yucca Mountain Repository. Waste treatment processes designed to treat wastes to meet these standards can be designed to produce wastes that can be delisted. The petition process for delisting is straightforward, and delisting standards are clear. Therefore, neither the cost of treatment nor the petition process is considered a barrier to delisting the waste. DOE would work with the states and the Environmental Protection Agency to ensure they had the information they needed to evaluate the delisting petitions.

6.1 (4810)
Comment - EIS000938 / 0005
This DEIS lists the materials (Table A-8, Volume 2, Page A-17) to be stored. They are careful in this table to not list the half life of the elements. This is an example of how DOE presents a report which on the surface the general public receives a feeling that it must be good. Look how thick it is. DOE is very careful not to blatantly lie but they come very close.

Response
In response to comments, DOE has added half-lives for all radionuclides identified for disposal at the proposed repository to Appendix A of the EIS (Section A.2.1.5.2 and elsewhere).

6.1 (4811)
Comment - EIS000938 / 0006
Vol. 1, Page 1-6, Paragraph 1.2.2.1, Commercial Spent Nuclear Fuel, DOE carefully describes the type of fuel stating that the material also contains actinides. The actinides are so dangerous that in 1973 a NASA [National Aeronautics and Space Administration] report with funding from the AEC [Atomic Energy Commission] stated that the study was conducted because although the actinides are a small fraction of the total waste the half life of some of the materials is over a million years. What I am concerned about is that this small fraction is equivalent to about 9 tons of which a percentage will be dangerous far beyond the 20,000 years that DOE states is the safe period for ALL the waste stored in the repository. The report is bogus if the actinides are included. Some of these will be carried by the underground water table and will end up concentrated in the food chain of future generations. This is in direct conflict with the enabling directive that the Federal Government shall protect future generations and the environment, (Page 1-1, Bullet 2). There is NO proof anywhere in this document that the actinides are not dangerous. Why is this small fraction not dangerous to the public safety, health and the environment of future generations and is in conflict with a published NASA report which describes the problem with actinides that are in the spent fuel rods. Are any of the nuclides specified in Table I-9 chemically toxic materials?

Response
The inventory described in Appendix A of the EIS includes radionuclides of the actinide series. The modeling of long-term performance including actinide-series radionuclides is discussed in Section I.3.1. The 18 actinides included in the analysis are listed in Table 1-5. Chapter 5 and Appendix I provide the environmental consequences of long-term repository performance. The EIS does not indicate that actinides are not dangerous; however, the repository design and the natural features of Yucca Mountain would act to isolate all types of radionuclides, including the actinides. The EIS analyzes the long-term performance of the repository to isolate them.

Extensive studies at Yucca Mountain show evidence of low rainwater infiltration and percolation rates, long groundwater residence times, and a repository horizon that has been hydrologically stable for long periods. The repository emplacement areas would be in areas away from faults that could adversely affect the stability of the underground openings or act as pathways for water flow that could lead to radionuclide release. DOE recognizes that some radionuclides would eventually enter the environment outside the repository. However, analysis of long-term performance shows that the combination of natural barriers of the site and engineered barriers would keep such a release small enough to cause no serious impact on the health and safety of people or the environment. The EIS based its analysis of impacts on a state-of-the-art modeling technique that is internationally recognized as an adequate and proper approach. The analysis of long-term performance used the radionuclides in the inventory with high potential for impact on human health, long half-life, high solubility, and low chemical sorption to estimate impacts to people (Section I.3 of the EIS). The results of the analysis indicate that the impacts for the 10,000-year evaluation period would be low and that health effects would be thousands of times less than natural incidences of health problems in the population.

Section I.3.2 of the EIS lists an inventory of chemical materials DOE would place in the repository, and Section I.3.2 discusses potential chemical toxicity. Section I.3.1.3 lists the radionuclide inventory for Greater-Than-Class-C and Special-Performance-Assessment-Required waste, which includes plutonium, a heavy metal that could have toxic effects. The radiological toxicity of plutonium far exceeds its chemical toxicity. In addition, while there are established radiological limits for exposure to plutonium, there are no such limits for chemical toxicity. Therefore, because DOE thoroughly evaluated the radiological consequences of plutonium and found them to be low, it did not analyze plutonium for chemical toxicity.

6.1 (5306)
Comment - EIS001805 / 0002
We urge the U.S. Department of Energy (DOE) to take all steps necessary to ensure that the first National repository is designed to accommodate all SNF [spent nuclear fuel] and HLW [high-level radioactive waste] without exceeding the limitations imposed by Congress.

We note two changes that will limit DOE's ability to dispose of the entire inventory of SNF and HLW under its purview at the proposed geologic repository.

First, DOE is using an outdated method for calculating the "metric tons of heavy metal" that can be disposed in the repository. Use of this overly restrictive and scientifically unjustified method will mean that the total volume of HLW waste cannot be disposed at the proposed geologic repository within congressionally imposed restrictions on the total volume to be accepted at the first repository. In order to resolve this first challenge, the INEEL CAB [Idaho National Engineering Environmental Laboratory Citizens Advisory Board] recommends that DOE adopt either the total radioactivity method or the radiotoxicity method as more equitable and scientifically justifiable method of calculating the metric tons of heavy metal in DOE's HLW inventory.

Second, DOE has stated that the proposed geologic repository will accept no waste with hazardous constituents as defined by the Resource Conservation and Recovery Act (RCRA). Much of the DOE-owned inventory of HLW is classified as RCRA hazardous and would therefore not be accepted for disposal at the proposed geologic repository. Under the current regulatory framework, two options exist that could allow eventual disposal of these hazardous wastes at the proposed geologic repository at some point in the future. DOE could decide to seek a permit for the geologic repository as a disposal facility under RCRA. Alternatively, DOE could seek to have HLW with hazardous constituents "delisted" following treatment to allow disposal in the geologic repository. Both strategies would likely prove quite difficult to implement. A third option is not in DOE's purview: It would involve congressional action to waive the requirement for a RCRA permit for the repository.

Metric Tons of Heavy Metal

The Nuclear Waste Policy Act was enacted in 1982 for the purpose of developing a geologic repository to protect the population and the environment from the hazards of radioactive waste. The Nuclear Waste Policy Act limited the amount of SNF and HLW to 70,000 metric tons of heavy metal (MTHM) that could be placed in the Nation's first geologic repository until a second repository could become operational.[1] The limitation was meant to provide "regional equity" among potential repository sites.

We understand that the material that could eventually go to the geologic repository includes civilian SNF (from commercial nuclear powerplants). DOE SNF (from DOE production reactors, naval reactors, and experimental reactors), and DOE HLW[2] (primarily waste that resulted from the chemical extraction of weapons-usable materials from defense SNF). In order to project the impacts that would result from the geologic repository, DOE must determine the quantities and characteristics of each of the three materials that would be disposed.

DOE determined that 90% (63,000 MTHM) of the 70,000 MTHM (allowed into the geologic repository) would be allocated for commercial SNF and the remaining 10% (7,000 MTHM) for DOE SNF and HLW. It has further been determined that 33% of the DOE's allotment (2,334 MTHM) would be allocated for DOE-owned SNF and 67% (4,666 MTHM) for HLW.

Calculation of the MTHM of SNF is relatively straight forward, based on the actual heavy metal content of the SNF. Calculation of the equivalent MTHM for HLW (which was not specified by Congress) is somewhat more complicated, however, and will affect the quantity of waste that can be accepted into the geologic repository. Both commercial SNF and DOE HLW contain the radioactive elements that are formed in a nuclear reactor. However, DOE SNF was generally retained in the reactor for a much shorter time than is the case for a comparable amount of commercial SNF. Because the amount of waste that is produced in SNF is dependent upon the length of time it stays in the reactor, much less radioactive waste material was produced per metric ton of DOE SNF compared to waste produced per metric ton of commercial SNF. In addition DOE's HLW consists only of the radioactive waste elements, which were separated from DOE SNF using a technology known as reprocessing, and no longer includes the heavy metals. Because of these differences, we recommend that the most consistent and comparable measure for comparing HLW with SNF is in terms of an "equivalent MTHM"--or the quantity of HLW that would produce the same radioactivity or radiotoxicity as a metric ton of SNF.

In the Draft EIS, impacts are evaluated using a method for calculating MTHM equivalence based on historical projections of radioactivity in HLW. Those historical projections are no longer valid, however, because the radioactivity levels in HLW now being produced are significantly lower. If the historical projections method is applied, the level of radioactivity that would result from each MTHM of HLW disposed in the geologic repository would be significantly lower than the level of radioactivity that would result from each MTHM of commercial SNF disposed. We believe there is no scientific basis for this inequitable and overly restrictive approach. In addition, the geologic repository capacity restriction of 4,666 MTHM for HLW will be inadequate to accommodate all of the HLW under DOE's purview if DOE uses the historical projections method.

The dilemma is recognized in Appendix A of the Draft EIS through the discussion of the methods for calculating MTHM. One method, the Total Radioactivity Method, would establish equivalence based on a comparison of the radioactivity inventory (curies) of HLW to the average curries found in a metric ton of commercial SNF. The second, the Radiotoxicity Method, would involve calculation of the "relative radiotoxicity" (based on the inventory of specific radionuclides present and their respective regulatory release limits). Using either of these two methods for calculating the MTHM equivalency for HLW would allow a more equitable allocation of storage space in the geologic repository between the commercial and DOE materials. Both of these alternative methods would allow DOE to dispose of all of its HLW at the geologic repository without exceeding maximum limits established by Congress.

Accordingly, the INEEL CAB recommends that DOE adopt either the total radioactivity method or the radiotoxicity method in this EIS as a more equitable and scientifically justifiable estimates of equivalent MTHM for the inventory of HLW. This approach would pose no additional risk to human health and the environment (above the risks evaluated in the Draft EIS). It would also reduce risks and costs associated with managing those risks at the sites where the undisposed HLW would remain, pending development of another repository at some undetermined point in the future.

Hazardous Constituents

Under its current design, the geologic repository will accept no waste with hazardous constituents as defined by the Resource Conservation and Recovery Act (RCRA). However, the DOE-owned HLW that is currently at INEEL contains listed hazardous constitutes and is classified as "RCRA hazardous[3]." In order for the HLW presently at INEEL to be disposed at the proposed geologic repository, various additional activities would have to occur. The INEEL CAB is concerned that the Draft EIS does not address what actions would be required to dispose of HLW that contains listed hazardous constituents, the impacts of those actions, nor the impacts of disposing those wastes at the proposed geologic repository. We note that these wastes constitute a significant portion of the HLW under DOE's control, and that DOE is responsible for permanent disposal of the entire inventory of HLW under the Nuclear Waste Policy Act.

Under the current regulatory framework, two options exist that could allow eventual disposal of these hazardous wastes at the proposed geologic repository at some point in the future. DOE could decide to seek a permit for the geologic repository as a disposal facility under RCRA within the state). Alternatively, DOE could seek to have the HLW with hazardous constituents "delisted" (following treatment) to allow their disposal in the geologic repository. That strategy would require documentation of the treatment methodology and extensive coordination among the states of Nevada and Idaho and two regions of the U.S. Environmental Protection Agency. Both strategies could prove difficult to implement. Nevertheless, the INEEL CAB recommends that DOE evaluate the Proposed Action in the Final EIS based on an assumption that all of the HLW with hazardous constituents will eventually go to the geologic repository for permanent disposal. This approach would allow development of environmental documentation that could support follow-on decision-making should DOE eventually overcome the challenges to acceptance of hazardous constituents at the geologic repository.

Closure of the Geologic Repository

The Draft EIS describes the Proposed Action ending with closure of the proposed geologic repository by 2033. The Idaho Settlement Agreement requires that DOE complete treatment of all HLW at INEEL, making it "road-ready" by the year 2035. The Draft EIS for Idaho's HLW and Facilities Disposition (HLW EIS), written in compliance with the Idaho Settlement Agreement, will allow meeting the 2035 deadline. As the geologic repository closure date is not specified by the Nuclear Waste Policy Act, the INEEL CAB recommends that it be extended to allow for acceptance of the INEEL's HLW.

Waste Acceptance Requirements

The DOE has begun specifying repository waste acceptance requirements for HLW from Savannah River and Hanford as well as other DOE SNF (in the Waste Acceptance Systems Requirements Document). Those requirements have been modified as more is known about the characteristics of the wastes after treatment. The INEEL CAB recommends that DOE further modify the Waste Acceptance Systems Requirements Document to accommodate the INEEL HLW forms described in the Draft HLW EIS.

Full Analysis

According to the "Purpose and Need for Action," in the Draft EIS, this EIS is being prepared to support DOE decision-making related to the Federal Government's responsibility for permanent disposal of all SNF and HLW. Therefore, the INEEL CAB recommends that each alternative include a full description of what would be done to manage the entire inventory of SNF and HLW, including any portions that would not be disposed at the geologic repository for any reason. In addition, the description of impacts under each alternative should include those impacts that would result from ongoing management of those wastes (any not disposed at the geologic repository) at their present locations.

Conclusions Regarding Our Recommendations for Changes to the EIS

If DOE incorporates all of the above recommendations, the Final EIS will:

Support informed decision making regarding future management of all SNF and HLW, in accordance with the federal government's responsibilities under the Nuclear Waste Policy Act.

Allow the design of the geologic repository to accommodate all of the SNF and HLW in DOE's inventory (within the capacity limitations specified in the Nuclear Waste Policy Act), and

Preclude the need for further environmental documentation under the National Environmental Policy Act, as the Final EIS would provide bounding estimates of the impacts of the geologic repository and other reasonable management alternatives for the entire inventory of SNF and HLW under DOE management.

1. The Draft EIS explains that: 1) quantities of SNF are traditionally expressed in terms of metric tons of heavy metal, not including other materials such as cladding and structural materials, 2) a metric ton is 1,000 kilograms or 2,200 pounds, and 3) uranium and plutonium are called heavy metals because they are extremely dense.

2. Including HLW from West Valley

3. HLW currently at Savannah River Site does not contain hazardous constituents and is believed to be acceptable at the geologic repository.

Response

In relation to the calculation of metric tons of heavy metal (MTHM), Appendix A of the EIS describes the basis for several methods for determining MTHM equivalence for high-level radioactive waste and explains that Congress would have to take legislative action to emplace more than 70,000 MTHM in the repository. This comment is correct in that, depending on the equivalence methodology, the total quantity of high-level radioactive waste that the 70,000-MTHM repository could include varies to a great degree. Since 1985, DOE has used the "historical method" (0.5 MTHM per canister) as a planning basis, as it did in this EIS to determine the number of canisters of high-level radioactive waste in the proposed repository. Using this method, the repository would include less than half of the high-level radioactive waste inventory. However, DOE has evaluated the consequences of repository disposal of the entire inventory of high-level radioactive waste. Specifically, Chapter 8 discusses cumulative impacts for the Proposed Action Inventory (which would include less than half the high-level radioactive waste canisters with the 0.5-MTHM-per-canister method) and for a Module 1 inventory (which would include the rest of the canisters). Using different equivalence methods would shift the proportion of the canisters that DOE could dispose of between the Proposed Action and the Module 1 Inventory, but would not have a major effect on cumulative impacts because spent nuclear fuel would dominate long-term repository performance results. Regardless of the equivalence method used, the EIS analyzes impacts from the disposal of the entire inventory of high-level radioactive waste such that bounding consequences are apparent.

The other equivalence methods, including the total radioactivity and radiotoxicity methods, would result in lower estimates of MTHM per canister. As such, these other methods would result in the acceptance of the total inventory of high-level radioactive waste in the repository. DOE is aware of these methods and discusses them in Appendix A of the EIS.

The purpose of the EIS is to evaluate the environmental consequences of the Proposed Action to construct, operate and monitor, and eventually close a geologic repository to dispose of 70,000 MTHM of spent nuclear fuel and high-level radioactive waste. It also evaluates reasonably foreseeable actions such as the disposal of a greater inventory of spent nuclear fuel and high-level radioactive waste representing maximum projected inventories of those materials. The EIS analyses are based on reference designs, conservative inventories, and conservative methodologies. DOE can consider and ultimately pursue disposal of the greater inventory of materials as long as the EIS appropriately assesses such disposal by evaluating the environmental consequences of such reasonably foreseeable actions. While the EIS evaluates the environmental consequences of disposal of more than 70,000

MTHM of spent nuclear fuel and high-level radioactive waste (Module 1 inventory), only Congress can set policy on the ultimate limits.

In response to the comment's concern about hazardous waste, current planning calls for a Yucca Mountain Repository to not accept wastes that are at the time of disposal either listed or characteristic hazardous wastes, as defined in 40 CFR Part 261.

DOE is aware that high-level radioactive waste at the Idaho National Engineering and Environmental Laboratory and the Hanford Site contains listed hazardous wastes. Such wastes would have to be "delisted" by the Environmental Protection Agency and the States of Nevada, Washington (for Hanford), and Idaho before DOE could dispose of them at a Yucca Mountain Repository because there are no plans for a Resource Conservation and Recovery Act permit for the repository. DOE would have to petition the Environmental Protection Agency to delist the waste. In addition, petitions to the States could be required.

DOE high-level radioactive waste could exhibit characteristics of hazardous waste (ignitability, reactivity, corrosivity, and toxicity) prior to treatment. The treated waste would not exhibit any of those characteristics. Characteristic hazardous wastes do not require a petition and rulemaking by the Environmental Protection Agency to exit the hazardous waste system.

Both listed and characteristic hazardous wastes would have to meet applicable *Land Disposal Restrictions Treatment Standards* (40 CFR Part 268) at a Yucca Mountain Repository. Waste treatment processes to meet these standards can produce wastes that are delistable. The petition process for delisting is straightforward, and delisting standards are clear. Therefore, neither the cost of treatment nor the petition process is considered a barrier to delisting these wastes. DOE would work with the states and the Environmental Protection Agency to ensure they have the information they need to evaluate the delisting petitions.

The EIS cumulative impact analysis includes all Idaho National Engineering and Environmental Laboratory high-level radioactive waste, as discussed above. The analysis assumed that receipt and emplacement of the entire Module 1 inventory of spent nuclear fuel and high-level radioactive waste would begin in 2010 and continue for 36 years, as discussed in Section 8.1.2.1 of the EIS. The dates a repository would become available, complete emplacement operations, and ultimately close are subject to many variables. It could close as early as 50 years or as late as 324 years after emplacement began.

The development of waste acceptance criteria documents is beyond the scope of this EIS. However, DOE does not believe that setting waste acceptance criteria without full consideration of input from the affected generators would be in their best interests. Therefore, the Department has instituted a program under which criteria development occurs through a formal technical review and comment process with all affected parties to ensure material transportation and disposal in a manner that would protect the public and provide long-term repository performance in compliance with the Environmental Protection Agency's public health and environmental radiation protection standards at 40 CFR Part 197.

6.1 (5318)
Comment - EIS001887 / 0051
Page 1-8; Section 1.2.5 - Other Waste Types with High Radionuclide Content

The Draft EIS fails to articulate an adequate legal rationale supporting the inclusion of wastes other than spent nuclear fuel and high-level radioactive waste as defined in the Nuclear Waste Policy [Act] of 1982, as amended. Particularly, there does not appear to be any legal justification for the inclusion of "Special-Performance-Assessment-Required" waste referred to in Section 1.2.5.

Response
As discussed in Section 1.5.1.1 of the EIS, comments received during the public scoping period requested that the EIS evaluate the potential acceptance of other waste types that could require disposal in a deep geologic repository in addition to the projected inventory of spent nuclear fuel and high-level radioactive waste. As a result, in Section 8.2 DOE analyzed the impacts of the disposal of Greater-Than-Class-C low-level waste and Special-Performance-Assessment-Required waste as reasonably foreseeable future actions. The introduction to Chapter 8 explains that

emplacement of these wastes at Yucca Mountain could require a determination by the Nuclear Regulatory Commission that these wastes require permanent isolation.

6.1 (5332)
Comment - EIS001887 / 0060
Page 1-23; Section 1.5.1.1 - Additional Inventory Studies

The Nuclear Waste Policy Act limits the amount of spent nuclear fuel that can be disposed in a Yucca Mountain repository. In addition, the Act does not authorize disposal of Greater-Than-Class-C or Special-Performance-Assessment-Required waste in a Yucca Mountain repository.

Response
In accordance with the NWPA, the EIS evaluates the impacts of the Proposed Action, under which the Yucca Mountain Repository would accept 70,000 metric tons of heavy metal of spent nuclear fuel and high-level radioactive waste. As discussed in Section 1.5.1.1 of the EIS, comments received during the public scoping period requested that the EIS evaluate the potential acceptance of the projected inventory of spent nuclear fuel and high-level radioactive waste, as well as other waste types that could require disposal in a geologic repository. In response to comments, Chapter 8 evaluates Inventory Modules 1 and 2 as reasonably foreseeable actions. Module 1 evaluates the complete inventory of spent nuclear fuel and high-level radioactive waste. Module 2 evaluates Module 1 plus a projected inventory of Greater-Than-Class-C and Special-Performance-Assessment-Required wastes. In addition, the introduction to Chapter 8 states that the emplacement of these wastes at Yucca Mountain would require legislative action by Congress unless a second licensed repository was in operation and could require a determination by the Nuclear Regulatory Commission that these wastes require permanent isolation.

6.1 (5338)
Comment - EIS001887 / 0063
Final Waste Management PEIS [Programmatic EIS] for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste (Waste Management PEIS)

This document characterizes and identifies the volumes of HLW [high-level radioactive waste] at DOE facilities nationwide and uses or updates previous Spent Nuclear Fuel information. The PEIS evaluates only the storage of immobilized HLW canisters. Treatment and disposal of HLW were not analyzed. However, the final disposition of these immobilized canisters is on-site storage "until shipment to a geologic repository for disposal." If this waste is to be disposed at a Yucca Mountain repository, the Draft EIS should evaluate both the treatment and disposal of this waste at Yucca Mountain.

Response
DOE would not treat high-level radioactive waste at the repository; therefore, the EIS evaluation of repository operations assumed receipt of high-level radioactive waste in its final treated form. Appendix A of the EIS describes the anticipated final waste forms and radiological characteristics of high-level radioactive waste. Section A.2.3 contains background information on ongoing treatment at DOE facilities and on future and ongoing EISs relevant to treatment options at other DOE facilities. Section 1.5.3 lists relevant environmental documents.

6.1 (5680)
Comment - EIS001887 / 0301
Section 6 of the Draft EIS purports to address the environmental impacts of transportation without ever specifically describing the radiological characteristics of spent nuclear fuel (SNF) and high-level radioactive waste (HLW) that cause the most serious adverse impacts of repository transportation on public health and safety and the environment.

Nevada believes that the impacts of repository transportation activities cannot be accurately assessed without explicitly acknowledging the deadly nature of SNF and HLW. Nevada's 1995 scoping comments recommended: "The radiological consequences of exposure and contamination associated with each reference fuel type should be presented in terms understandable to the general public, and these consequences should be presented in the Executive Summary as well as in the body of the draft EIS." DOE has chosen to ignore Nevada's recommendation.

Section 6 contains no meaningful discussion of the radiological characteristics of the reference fuel types to be transported to the repository. Indeed, the Draft EIS overall barely discusses the radiological hazards of SNF. The Executive summary states that spent nuclear fuel “consists mostly of uranium, and is usually intensely radioactive because it also contains a high level of radioactive nuclear fission products.” (p. S-4) The overview section of Volume 1 states that spent nuclear fuel “is intensely radioactive in comparison to non-irradiated fuel.” (p. 1-6) Except for identifying Cesium-137 as a major source of SNF preclosure impacts and shielding requirements (p. A-9), Appendices A, F, and J provide little specific information on the hazards of SNF.

DOE has designated a 26 year-old PWR [pressurized-water reactor] spent fuel assembly with 39,560 MWd/MTHM [megawatt-days per metric ton of heavy metal] burn-up and 3.69 percent Uranium-235 initial enrichment as the “typical fuel type” for transportation impact analysis in Section 6 of the Draft EIS. (p. A-14) All other factors being equal, cooling time is the single most important determinant of transportation radiological risk. The 26 year-old SNF assumed in the Draft EIS is considerably less dangerous than the 10 year-old SNF assumed in past DOE program documents, and much less dangerous than the 5 year-old SNF that could be shipped to the repository in casks currently licensed by the NRC [Nuclear Regulatory Commission].

The typical PWR assembly described in the Draft EIS contains 31,000 curies of Cesium-137 and 21,000 curies of Strontium-90, and is a powerful source of penetrating gamma and neutron radiation. A person standing next to a single, unshielded 26 year-old SNF assembly for a few minutes would receive a radiation exposure sufficient to cause death in 50 percent of the population. Extend the time to ten minutes, and death from classic radiation sickness replaces concern about latent cancer fatalities.

Response

The EIS includes detailed discussions of the radiological impacts associated with the Proposed Action. The impacts include the consequences associated with normal incident-free conditions and accident scenarios, including transportation. Chapter 6 of the EIS discusses in detail potential impacts from transporting spent nuclear fuel and high-level radioactive waste from 72 commercial and 5 DOE sites to Yucca Mountain. Appendix J includes details of the analysis and methodology used to determine transportation impacts. Appendix A provides the inventory and characteristic information that DOE used throughout the EIS analyses, which reference that appendix in each applicable section. To clarify the inventory information used in the transportation analysis, DOE has added a new reference to Appendix A to the introduction to Chapter 6.

Chapter 1 of the EIS discusses in general terms each type of fuel that would be in the repository inventory. The discussion of fuel types in Chapter 1 and the Summary note in simple, understandable terms that the main hazard associated with spent nuclear fuel is “radioactivity” and that spent nuclear fuel is intensely radioactive. Appendix A contains more technical information, such as the amount and type of radioactivity, the final waste form, physical characteristics, mass and volume, chemical composition, thermal output, and canister data.

DOE does not believe it has misrepresented the spent nuclear fuel characteristics in the Draft EIS. Section A.2.1.5 of the Final EIS provides the bases for selecting average pressurized-water reactor and boiling-water reactor fuel assemblies. These fuel assemblies replace the “typical” fuel assemblies in the Draft EIS and are based on more recent projections of commercial spent nuclear fuel shipments to the repository. Specifically, DOE selected the average assemblies to be representative of the average of the fuels the repository would receive and to provide a realistic estimate for analysis. The average commercial assemblies specified are used in the Final EIS for calculating the repository inventory and post-irradiation elemental distribution.

The Final EIS includes a revised “representative” commercial fuel for calculating impacts of potential accidents. The representative fuel is based on a Hazard Index approach that considers the relative hazard of all commercial spent nuclear fuel that DOE could receive at the repository. This fuel would be younger (fewer years since removal from the nuclear reactor) and have higher burnup (more energy extracted from the fuel) than the typical commercial fuels analyzed in the Draft EIS. The use of the bounding fuel (maximum burnup and minimum cooling) is not appropriate for transportation accident analysis because DOE would not fill transportation casks with such fuel. The bounding fuel would exceed the thermal and direct radiation exposure limits for high-capacity transportation casks; therefore, shipments of such fuel would be in casks that carried fewer fuel assemblies than the large-capacity casks DOE assumed for the Draft EIS analyses. Furthermore, the bounding fuel represents a very small fraction of the spent nuclear fuel inventory. Thus, an accident involving shipment of bounding fuel would not be reasonably foreseeable; that is, the likelihood of such an accident would be less than 1 in 10 million per year of transportation. In addition, potential accidents associated with the bounding fuel would be less severe than the maximum reasonably foreseeable accident evaluated in the EIS because there would be fewer fuel assemblies in each cask. The Final EIS defines the parameters of representative commercial spent nuclear fuel and the rationale for developing the representative fuel type for use in the accident analysis (Appendix A).

6.1 (5998)
Comment - EIS001879 / 0026
p. A-18 - Table A10 [Section A.2.1.5.2]

The summation of the grand totals for the individual radionuclides should be calculated and presented in this table.

Response
The table in Section A.2.1.5.2 of the EIS lists the estimated number of curies in 50 separate isotopes in commercial spent nuclear fuel, each of which DOE used in the evaluation of impacts. DOE did not sum the individual radionuclides because a grand total could be misleading due to the wide variation of potential health effects among nuclides. For example, a curie of plutonium could cause a much greater effect to human health than a curie of cesium, which could cause a much greater effect than a curie of tritium. For that reason, the EIS estimates radiological dose to humans in rem or millirem.

6.1 (6614)
Comment - EIS002101 / 0004
When these casks start rolling in -- I've been at your meetings where you haven't had the audacity to pull it out today, but fake spent fuel rods, parading around like look, this is a spent fuel rod, totally safe, totally nice, but it's been in water. Anybody here who has ever taken out a hot water heater knows that you get corrosion around your elements. There's a lot of -- of minerals and so on that's attached itself to those fuel rods that is also highly radioactive.

Response
This comment that a "clean" spent nuclear fuel rod does not have corrosion or "crud" as a spent nuclear fuel rod would have is correct. The EIS analysis modeled spent nuclear fuel rods in determining the environmental impacts of repository and transportation activities. Section H.2.1.4.1.1 describes the buildup of crud on the outside of the fuel rod cladding and how crud becomes radioactive from neutron activation. The EIS impact analyses included this radioactivity.

6.1 (6857)
Comment - EIS001466 / 0004
What is in these casks that will be rolling through Utah? And I'm from Michigan and I've only been in D.C. a few months. I've worked on this issue for over a decade. I lived about 35 miles from the Palisades nuclear plant.

And so this high-level waste, these are the fuel rods that come out of the core of the reactors. They're up to a million times more radioactive coming out than when they went in, and if you were to be within a yard of this stuff -- depends on how long it's been out of the core. If it's just come out of the core, then your lethal exposure could be in a matter of ten seconds; if it's been out for a number of years, your lethal exposure could be in a number of minutes.

So this material needs to be shielded, it needs to be isolated from the environment. Because of the long duration of the hazards of some of the radionuclides, it needs to be isolated from a living environment for hundreds of thousands of years.

Response
Spent nuclear fuel must be shielded and isolated to protect the environment and ensure the public's health and safety. DOE would ship spent nuclear fuel in casks certified by the Nuclear Regulatory Commission and designed to withstand severe accidents and provide sufficient shielding to meet U.S. Department of Transportation regulations on radiation exposure rates (49 CFR 173.441). As discussed in Section 6.2.3 of the EIS, radiation exposure to an individual near the route or near a rail yard could be as high as 300 millirem over the 24 years of the transport

campaign. The dose to an individual in a traffic jam immediately adjacent to a truck shipment could be as high as 20 millirem. In relation to environmental isolation, DOE believes that its proposed operational plan for a Yucca Mountain Repository provides a design and management approach that would isolate waste materials from the public and the environment for the foreseeable future, thereby ensuring the health and safety of the public.

6.1 (7198)
Comment - 010322 / 0006
Again on the fuel blending, and this is something new in the Supplement that I saw. Now, to do fuel blending you have to know the exact history of all the assemblies, as I understand it. Because the reactor sites, they do keep records and so on and so forth, but records often have mistakes.

And studies have been done that mistakes have been made in record keeping and the actual age of the fuel assembly. And I didn't see a really thorough evaluation of what would happen if those records were incorrect, fuel was blended that was thought to be older than it actually is, and what the consequences of that would be. And that's a big concern.

Response
A recent evaluation considered misloading of a waste container and found the event to be credible (DIRS 103237-CRWMS M&O 1998). However, DOE intends to develop waste container loading procedures based on thermal analyses of the various waste container configurations such that sufficient margin would be available to ensure that the waste package surface temperature design criteria would not be violated for any credible misload. Furthermore, extrapolation of the results of a recent waste package thermal analysis (DIRS 154278-CRWMS M&O 2001) indicates that the maximum thermal misload (all 5-year-old pressurized-water reactor spent nuclear fuel, the hottest fuel that could be shipped to the repository) would not result in waste package failure from excessive temperature. The accident analysis in Appendix H includes the failure of a waste package resulting from high-speed impact on the access tunnel wall following failure of the transporter (transporter runaway). The impacts from this accident, which include releases resulting from mechanical damage of the fuel, would bound the impacts from failure of a waste package as a result of thermal overload.

6.1 (7461)
Comment - EIS000817 / 0008
You have low-level waste BPRAs [burnable poison rod assemblies], etc. being put in HLW [high-level radioactive waste] containers. No low-level waste should take up room in a HLW repository. It's going to cause a problem if DOE has to take low-level waste out of the casks at Yucca Mountain packaging facility. Yet utilities are mixing low-level in with high-level assemblies in dry storage at their reactors. This should not be allowed... The NRC [Nuclear Regulatory Commission] withdrawal of the direct final rule to allow the VSC-24 [Ventilated Storage Cask, Model 24] cask certificate to be amended to allow putting BPRAs in the assemblies. I sent in comments, but I don't know what caused the withdrawal specifically. One of my concerns was putting low-level waste in high-level waste containers. Those assemblies are eventually bound for Yucca Mountain and a high-level waste repository with limited space and radiation and thermal loads is no place for low-level waste. NRC should not allow utilities to put them in casks now. What is [the] DOE position on this?

Response
The Standard Contract between DOE and the nuclear utilities (10 CFR Part 61) states that nonfuel components including, but not limited to control spiders, burnable poison rod assemblies, control rod elements, thimble plugs, fission chambers, and primary and secondary neutron sources, that are contained in the fuel assembly, or boiling-water reactor channels that are an integral part of the fuel assembly, which do not require special handling, could be included as part of the spent nuclear fuel delivered for disposal pursuant to the Standard Contract.

As long as the commercial nuclear utilities abide by the contract and meet the Yucca Mountain waste acceptance criteria, DOE is obligated to receive the spent nuclear fuel and its associated nonfuel assembly hardware for disposal in the proposed repository. The Nuclear Regulatory Commission will review the Yucca Mountain waste acceptance criteria, which would become part of the operating license issued by the before construction and operation of the repository.

6.1 (7497)
Comment - EIS001909 / 0001
The Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada, DOE OCRWM, DOE/EIS-0250D, July 1999 (hereinafter referred to as the DEIS) fails to address the single most important issue which affects risk reduction, namely, the apportionment of commercial spent nuclear fuel (SNF) and DOE high-level radioactive waste (HLW) and spent fuel within the disposal inventory limit set by Congress in the NWPA, i.e., 70,000 metric tons of heavy metal (MTHM). While this issue is clearly within the scope of the DEIS, and is in fact referenced in the DEIS with regard to an administrative decision made by DOE which establishes the MTHM ratio of SNF and HLW, no analysis is presented with regard to the risk reduction achieved by different disposal ratios of commercial SNF and DOE waste within the 70,000 MTHM Congressional limit....

The Yakama Nation (YN) entered into a Treaty with the United States government on June 9, 1855 (Treaty of 1855, 12 Stat 951). This Treaty was entered into pursuant to the laws of the Yakama and the U.S. Constitution, and was signed by the President of the United States on April 18, 1859 following ratification by Congress. It is in full effect today.

The YN retains perpetual rights on open and unclaimed land within the boundaries of the territory ceded to the United States government in the Treaty of 1855. The Hanford nuclear site is on YN ceded land. Due to the Hanford site's proximity to the Yakama Nation Reservation, the YN is affected by Hanford activities on its Reservation land as well as from impacts to the Hanford ceded land. In addition, the Hanford site creates off-site impacts which affect YN reserved rights on other areas of its ceded territory, including the Columbia River.

The greatest inventory of HLW and DOE SNF in the United States is located on YN ceded land at the DOE's Hanford site. Most Hanford HLW is stored in leaking underground tanks, but some HLW has now contaminated the vadose zone under the tanks, and some has reached the unconfined aquifer which flows into the Columbia River. This HLW poses acute as well as chronic risks to human health and the environment, resulting from its mobility into the environment, its extreme toxicity, and its long-lived activity. DOE SNF at Hanford is considered an acute risk as well, resulting from the degraded nature of containment, and the potential for a catastrophic release to the Columbia River. It is therefore of the greatest importance to the YN government that the United States fully consider any actions with regard to retrieval, processing, and disposal of this HLW which may affect the perpetual Treaty rights of the YN.

As mentioned above, the YN does not consider the analysis in the DEIS adequate at this time. The single greatest factor within the scope of the DEIS which affects risk reduction, including risk reduction to Yakama Tribal members and YN resources which are protected by Treaty, is the apportionment of commercial SNF and DOE waste in the proposed repository.

The human health and environmental risks posed by Hanford HLW are significantly greater than those posed by commercial SNF, and that risk may increase substantially as the Hanford HLW tanks continue to deteriorate and fail, and unless the Hanford SNF is stabilized and isolated from the environment. The most important and necessary analysis for the proposed Yucca Mountain repository is a comparative analysis of the risks of storage of DOE HLW and SNF relative to those of commercial SNF, prior to waste acceptance at a repository. This analysis is mandatory before DOE, Congress, and affected governments, including the YN, may have confidence in the SNF and HLW disposal program.

When the proposed analysis is conducted, it should fully account for the distinct pathways and risks posed to Native Americans, including YN Tribal members. (Please reference "Estimation of Health Risk Based on Revised Estimates of HEDR Doses for Maximum Representative Individuals Consuming Fish and Waterfowl from the Columbia River: An Evaluation of HEDR Reports on the Columbia River Pathway," Agency for Toxic Substances and Disease Registry, Atlanta, Georgia, March, 1998.)

Risks of DOE Hanford HLW and SNF vs. Commercial SNF

Hanford HLW exists in an extremely hazardous form. It consists of sludge, saltcake and liquids which are unstable and have numerous constituents which have reacted to form flammable gasses and potentially explosive compounds.

While extensive work has been undertaken over the past decade to assess and mitigate the risks posed by potential explosions in the Hanford HLW tanks, the reality is that characterization data does not exist at the level necessary to ensure that an explosion may be ruled out. DOE Hanford SNF is stored in a leaking basin which could fail during an earthquake, and the SNF elements have corroded and released HLW sludge to the basin floor. Commercial SNF, by comparison, is in the form of a solid with well defined characteristics, has more robust cladding, and is stored under stringent standards.

Hanford HLW has been released to the environment, and containment continues to fail. Once radioactive materials are present in the accessible environment, the risks posed to human health and the environment increase dramatically. Not only has Hanford HLW already impacted the accessible environment, but it is certain that those impacts will increase in the near term. Hanford HLW has been confirmed in the vadose zone, and HLW constituents have reached groundwater in some locations. Similar to the lack of characterization data, data on the extent of HLW contamination to the vadose zone and groundwater is incomplete. DOE Hanford SNF has released radionuclides into the soil from leaks in the basin. Commercial SNF remains contained and isolated from the accessible environment.

Hanford HLW is likely to produce unforeseen and unpredictable risks in its interactions with the environment. Unlike commercial SNF, which exists in a well-characterized and stable form, Hanford HLW constituents (sludge, saltcake, and liquids comprised of organic, inorganic and heavy metal radionuclides and chemical wastes) present significant risk assessment challenges. In short, Hanford HLW poses greater risk relative to commercial SNF once released to the environment by virtue of its composition. Similarly, DOE Hanford SNF exists in a form which is more difficult to retrieve from the environment than commercial SNF.

Section 1.4.2 -- "The Nuclear Waste Policy Act requires the Nuclear Regulatory Commission to include in the authorization a prohibition against the emplacement of more than 70,000 MTHM in the first repository until a second repository is in operation [Nuclear Waste Policy Act, Section 114(d)]. DOE has allocated 63,000 MTHM of commercial spent nuclear fuel and 7,000 MTHM equivalent of DOE spent nuclear fuel and high-level radioactive waste to the proposed repository at Yucca Mountain."

The DOE allocation of 7,000 MTHM equivalent of DOE SNF and HLW is one of the most significant factors in risk exposure considered in the DEIS -- yet no analysis is presented regarding the basis for this decision. In fact, this decision should have been fully subject to NEPA [National Environmental Policy Act] analysis, and alternatives presented for various repository allocations between commercial spent fuel and DOE spent fuel and HLW.

Response

DOE is implementing a plan to retrieve and stabilize the waste in the Hanford tanks to provide long-term protection of human health and the environment. As noted in the Tank Waste Remediation System EIS (DIRS 103214-DOE 1996) and its Record of Decision (62 *FR* 8693; February 26, 1997), the Department and the Washington State Department of Ecology have agreed to a plan that would isolate the tank waste from humans and the environment, and provide for the protection of public health and the environment until final disposition in a repository. The planned treatment will reduce the potential risk from such waste to a level similar to or less than the risk from spent nuclear fuel. As a consequence, the apportionment between DOE waste at Hanford and commercial spent nuclear fuel would not affect the EIS or Site Recommendation schedules.

DOE is carefully weighing and balancing a number of issues, such as priority based on risk, to determine the optimum shipping scenario that would include both commercial and DOE spent nuclear fuel and high-level radioactive waste, but has not set a specific order. DOE has been working on an optimized shipping schedule for the past 2 years based on acceptance rates for DOE spent nuclear fuel and high-level radioactive waste.

In relation to the 7,000 metric tons of heavy metal apportionment, DOE decided to allocate 10 percent of the capacity of the first repository for the disposal of DOE spent nuclear fuel and high-level radioactive waste (DIRS 104384-Dryfuss 1995; DIRS 104398-Lytle 1995). The 10-percent apportionment is simply an assumption for EIS analyses. Section A.2.3.1 of the EIS discusses the 10-percent allocation.

6.1 (7526)
Comment - EIS001723 / 0001
You're speaking of storing 77,000 metric tons of waste in the mountain.
Well, what is a metric ton? One metric ton is 2,200 lbs. So, then, 77,000 metric tons are 169,400,000 lbs.

How do we visualize what kind of volume we're speaking of, and how impractical this project really is?

Most of us drive cars, so let's use them as our example. Let's say for the sake of argument, they weigh 3,500 lbs. each. If I've done the math right, we are looking at trying to park 4,840,000 cars inside Yucca Mountain. Will they fit? Probably not!

Response
The Proposed Action for this EIS is to dispose of 70,000 metric tons of heavy metal (MTHM) of spent nuclear fuel and high-level radioactive waste in the proposed geologic repository. Appendix A of the EIS provides information that correlates the 70,000 MTHM of materials into volume. The total volume of materials that DOE projects it would emplace during the Proposed Action is approximately 40,000 cubic meters (52,000 cubic yards). Depending on the repository operating mode, which would affect the size of the repository, DOE would excavate between 4.4 and 8.8 million cubic meters (5.8 to 12 million cubic yards). Emplacement drifts would have a diameter of 5.5 meters (18 feet). Accounting for spacing between waste packages and the waste packages themselves, the repository would be more than adequate to accept the volume of material proposed.

6.1 (7590)
Comment - EIS001909 / 0007
Section A.2.3.1

"There has been no determination of which waste would be shipped to the repository, or the order of shipments."

This statement reveals the lack of analysis presented in the DEIS. Yucca Mountain, if it is licensed for acceptance of waste, will provide disposal capacity for actual commercial SNF and DOE HLW and SNF. The DEIS should provide a range of scenarios for which waste is proposed to be shipped to a generic repository, so the impacts of those scenarios may be evaluated.

Response
DOE is carefully weighing and balancing a number of issues to determine the optimum shipping scenarios that would include both commercial and DOE spent nuclear fuel and high-level radioactive waste, but the Department has not set a specific order. Because it would be at least 8 years before the repository could begin accepting spent nuclear fuel and high-level radioactive waste, the process used to determine the shipping order would likely continue to evolve for several more years. The process for determining shipment order would not impact the EIS or Site Recommendation schedules. DOE looks forward to working with its stakeholders during this time period as the process continues.

6.1 (7595)
Comment - EIS001909 / 0008
Section A.2.3.5.4

"In the extreme, the nonuniform blending of cesium concentrates and capsule materials into a relatively small volume of sludge waste could produce a few canisters with specific powers as high as 2,540 watts, which is the limit for the nominally 4.5-meter (15-foot) Hanford canisters in the Civilian Radioactive Waste Management System Baseline (Picha 1997, Attachment 1, page 2; Taylor 1997, all)."

The consideration of actual waste forms and waste package characteristics points to the need for a careful analysis of [the] waste inventory considered for disposal, and specifically the impacts of waste packages which may be stored for an indefinite period prior to acceptance for geologic disposal in a repository.

Response
DOE is considering actual waste forms and waste characteristics, which is why Appendix A includes information on the few Hanford high-level radioactive waste canisters that could have higher thermal outputs. The surface facilities design in the EIS includes staging and pool storage for canisters. Current plans call for putting the spent nuclear fuel and high-level radioactive waste received at the proposed repository in new waste packages at the surface facilities before emplacement. In the case of DOE materials, the canisters in which the material arrived at the repository would be placed directly in the waste packages to be emplaced.

6.1 (7600)
Comment - EIS001909 / 0009
Section A.2.3.5.7

"Hanford Site. DOE could need to ship such nonstandard high-level radioactive waste [HLW] packages as failed melters and failed contaminated high-level radioactive waste processing equipment to the repository. For this EIS, the estimated volume of nonstandard packages available for shipment to the repository from the Hanford Site would be equivalent to that described below for the Savannah River Site."

Table A-38 provides an estimate of 10 melters, 4.5 equivalent DWPF [Defense Waste Processing Facility] canisters for each melter, 1,000 metric tons for 10 melters, with one melter per disposal package.

The DEIS should fully consider Hanford HLW [high-level radioactive waste] in addition to tank waste, failed melters, and failed HLW processing equipment. In particular, the DEIS should provide an analysis of the fraction of Hanford HLW currently planned for separation and disposal at the Hanford site, by mass, volume and radionuclide content.

Response
The EIS considers all waste at the Hanford Site that DOE has declared to be high-level radioactive waste, including the vitrified high-level tank waste (with strontium and cesium capsules from the water basin blended into the tank waste) and the nonstandard packages (failed melters and processing equipment). Appendix A provides detailed information on these waste forms, including mass and volume, amount and nature of radioactivity, chemical composition, and thermal output. DOE has not declared other miscellaneous materials or wastes at the Hanford Site, either existing or forecast, to be candidate high-level radioactive waste streams and, therefore, has not evaluated other wastes in this EIS.

Because the Nuclear Waste Policy Act of 1982 limits the amount of spent nuclear fuel and high-level radioactive waste to 70,000 metric tons of heavy metal, the Proposed Action cannot include the total expected inventories of these materials. However, Chapter 8 of the EIS discusses the analysis of environmental impacts of inventories larger than that evaluated for the Proposed Action.

6.1 (7947)
Comment - EIS001903 / 0011
The Summary and main body of the EIS should explain the basis of the allocation and prioritization of DOE high-level waste shipments to the repository. The proposed action must consider the transfer of INEEL [Idaho National Engineering and Environmental Laboratory] high-level waste to the proposed Yucca Mountain repository. This information should not be hidden in an obscure table in an Appendix.

Response
Section 1.2 of the EIS discusses the types and quantities of radioactive material under consideration for repository disposal. Section 1.2.3 notes that the inventory of material being considered includes high-level radioactive waste at the Idaho National Engineering and Environmental Laboratory and refers to Appendix A for inventory details, including waste characteristics and volumes. Section A.2.3 provides the current status of Idaho National Engineering and Environmental Laboratory high-level radioactive wastes in the total inventory, treatment options, planned treatment dates, and proposed dates to ship such wastes to a repository. Section A.2.3.1 specifically notes that, using the historical method of estimating the metric tons of heavy metal equivalence, DOE could not dispose of all high-level radioactive waste in the current Proposed Action inventory allocation of 4,667 metric tons of heavy

metal. It also notes that DOE has not determined which waste it would ship to a repository or the order of shipments.

Because it would be at least 8 years before a repository could begin accepting spent nuclear fuel and high-level radioactive waste, the process DOE used to determine which waste it would ship and the shipping order would continue to evolve. DOE would work with its stakeholders during this period.

6.1 (8217)
Comment - EIS001873 / 0019
Chapter 8 should be expanded to include spent fuel that could be generated by new power plants or future DOE activities. The question to ask is: What is the maximum quantity of radioactive waste that could be sent to the Yucca Mountain area without the benefit of another complete EIS, and what would be the impacts of this expansion of the Project?

Response
Appendix A and Section 8.2 of the EIS address the potential for as much as 105,000 metric tons of heavy metal of commercial spent nuclear fuel that the operation of commercial nuclear reactors could generate. This value includes the assumption that the Nuclear Regulatory Commission would grant 10-year extensions of the operating licenses to all of the existing reactors. This projection from the Energy Information Administration is the most conservative projection of total spent nuclear fuel that could be generated. There are currently no plans to construct any new commercial reactors. Appendix A and Chapter 8 also address the total expected volume of spent nuclear fuel and high-level radioactive waste that DOE activities would generate.

6.1 (8409)
Comment - EIS001873 / 0074
P. 8-5. DOE should include spent nuclear fuel from new reactors that may be licensed in the future if Yucca Mountain is expanded.

Response
Appendix A and Section 8.2 of the EIS address the potential for as much as 105,000 metric tons of heavy metal of commercial spent nuclear fuel that the operation of commercial nuclear reactors could generate. This value includes the assumption that the Nuclear Regulatory Commission would grant 10-year extensions of the operating licenses to all of the existing reactors. This projection from the Energy Information Administration is a conservative projection of total spent nuclear fuel that could be generated. There are currently no plans to construct any new commercial reactors. Appendix A and Chapter 8 also address the total expected volume of spent nuclear fuel and high-level radioactive waste that DOE activities would generate.

6.1 (8571)
Comment - EIS000817 / 0179
P. A-28. Mixed Oxide -- you don't know if this will even work in Canadian reactors yet, so how can you say this? Wow! When I look at all the variables for material interactions here in all these waste forms -- I say leave it in the casks -- separate from each other.

Response
The mixed-oxide fuel discussed in Section A.2.2.4 of the EIS is existing DOE spent nuclear fuel that the Department would ship from the Hanford Site or the Idaho National Engineering and Environmental Laboratory. This is not the mixed-oxide fuel proposed to provide a means of disposing of surplus plutonium, which is described in Section A.2.4.5.1.

6.1 (8572)
Comment - EIS000817 / 0180
A-34. Can you solve the vitrification process problems or has this idea been discarded? How stable is borosilicate glass? Certainly all problems with this and electrometallurgical treatment needs to be solved before any repository decision is made.

Response
The vitrification process solidifies and immobilizes high-level radioactive waste into a borosilicate glass or ceramic form inside stainless-steel canisters. Although vitrification poses technical challenges, DOE has used it successfully for several years at the Savannah River Site in South Carolina and the West Valley Demonstration Project in New York (see Section A.2.3 of the EIS). It is a viable process for immobilizing high-level radioactive waste.

DOE has conducted considerable research on the various waste form materials. This information has been used to develop models of how these materials would perform over long periods in a repository environment. For example, models of commercial spent nuclear fuel dissolution are based on experimental tests in which actual reactor fuel was been used. The models for borosilicate glass and the plutonium ceramic are also based on extensive testing. Dissolution and degradation models for borosilicate glass have been under development for more than 25 years, and there has been extensive testing of plutonium ceramic degradation for several years to support the Yucca Mountain Project. While all these waste forms eventually degrade and dissolve, the process is extremely slow, being characteristic of reactions of water on glass and ceramic materials where time scales are in the hundreds of thousands of years (DIRS 153246-CRWMS M&O 2000).

Details about these dissolution models used in the Total System Performance Assessment are described in Appendix I of the EIS.

In September 2000, DOE selected electrometallurgical technology to treat spent nuclear fuel from the Experimental Breeder Reactor-II at Argonne National Laboratory-West near Idaho Falls, Idaho (65 *FR* 56565; September 19, 2000). In addition, the Department will further develop alternative technologies that might provide cost savings or other benefits for similar fuel from the Fermi-1 Reactor. This decision followed the successful completion in August 1999 of a 3-year research and development demonstration project of this technology. An independent National Research Council review found no technical barriers to the use of this technology to treat Experimental Breeder Reactor-II fuel. However, DOE will continue to investigate alternative treatment techniques while monitoring the results and costs of the electrometallurgical treatment of Experimental Breeder Reactor-II fuel. Data evaluated through the National Environmental Policy Act process indicate that DOE might be able to take advantage of the differences in the Fermi-1 and Experimental Breeder Reactor-II fuel to save money by treating the two fuel types with different techniques. If no alternative is more cost effective for the Fermi-1 spent nuclear fuel, however, electrometallurgical treatment remains a viable option.

6.1 (8589)
Comment - EIS001837 / 0003
Your Programmatic Waste Management DEIS fails to reflect the diversity of nuclear waste and the fact that we need a new classification system. The DEIS fails to address the issue that nuclear materials are more safely stored on site until decay, according to its classification as an element or isotope. An entire rewrite of the entire national management policy in Washington D.C. must exact the management for various isotopes depending upon specific radioactivity or decay life. Even in our own homes, we separate the brown bottles from the clear bottles. The nuclear industry must approach the various elements and isotopes the same way. No further expenditures should be made or rulemaking imposed regarding nuclear waste disposal plans until after the entire National Policy on nuclear waste management can be reviewed and revised by a Blue Ribbon Commission as per proposed SBA 540.

Currently, our nation's nuclear waste is misclassified and much of the so called low level nuclear waste should in reality be included in any management proposal for high level nuclear waste and/or mixed waste. The classification wording "high" and "low" level waste is deceitful and misleading. The same isotopes are included in both waste forms. High level waste can become low level simply by mixing and diluting the shipment. Your representative at the 2/22/00 hearing in San Bernardino claimed that there would be no liquid waste, but when she says this, she misleads the public. The DOE should be honest with the public and letting the public know that they mean something else. The drums or casks or shipment containers can have so much percentage liquid and still not be called liquid waste. The DOE can allow the liquid waste to be sopped up with toilet paper or whatever and not call it liquid. This is a classification problem.

Response
The purpose of this EIS is to evaluate the consequences of the Proposed Action to construct, operate and monitor, and eventually close a geologic repository and of a No-Action Alternative. The classification of high- and low-level

radioactive waste and definition of acceptable amounts of residual liquids in waste packages is the responsibility of the Nuclear Regulatory Commission, the U.S. Department of Transportation, and Agreement State and disposal facility regulations and is, therefore, beyond the scope of this EIS. The inventory in the EIS evaluations included all projected spent nuclear fuel and high-level radioactive waste, as defined by the Nuclear Regulatory Commission. For reference, the EIS Glossary (Chapter 14) contains definitions for high- and low-level radioactive waste.

With regard to the comment that "high level waste can become low-level simply by mixing and diluting the shipment," high-level radioactive waste cannot be diluted with other less-concentrated isotopes of the same material to obtain low-level waste because, as currently defined, high-level radioactive waste is a source-based definition, and such dilution is not acceptable.

6.1 (9063)
Comment - EIS000489 / 0001
The draft EIS provides insufficient information on the radiological characteristics. We find this particularly galling because we spent a lot of time during the scoping process in 1995 specifying what we thought should be in the draft EIS.

Response
The level of information in Appendix A of the EIS on the radiological characteristics of the repository wastes is sufficient to assess the environmental impacts of both the Proposed Action (to construct, operate and monitor, and eventually close a geologic repository) and the No-Action Alternative. Appendix A provides considerable information on the types and amounts of radioactivity involved in each waste form. The information includes the final waste form, physical characteristics, mass and volume, amount and nature of radioactivity, chemical composition, thermal output, and canister data.

6.1 (9064)
Comment - EIS000489 / 0002
Now, I will give DOE credit. In some areas they did a very good job in a very difficult task. So many different types of highly radioactive materials are being shipped to the repository to come up with a few good reference ones you can meaningfully manage the analysis of is quite difficult.

For those of you who are concerned about the DOE defense cleanup, I particularly recommend looking at the part of the EIS in Appendix A around page 23. A very good job was done, in my opinion, picking a representative DOE spent nuclear fuel waste form.

Response
Thank you for your comment.

6.1 (9102)
Comment - EIS001822 / 0002
A recent article in the journal Science (see summary below from Chemical & Engineering News) shows that our government is ignoring work performed by their own nuclear chemists:

To begin with, the LANL [Los Alamos National Laboratory] research answers decades-old questions about fundamental plutonium properties like color and oxidation state. Haschke points out that PuO2 [plutonium dioxide] is dark yellow. The green color that has been observed previously is due to the higher oxide, he says--not impurities, as some have suggested.

And contrary to the commonly held view that the oxidation state of plutonium in the stable oxide is exclusively Pu(IV), the present work shows that PuO2 can be oxidized as high as $PuO_{2.27}$, suggesting that more than 25 percent of plutonium atoms are in the Pu(VI) state.

The study also provides another mechanistic explanation for the production that's been observed during plutonium hydrolysis and oxidation. Gas evolution in sealed storage containers leads to pressure buildup--a serious concern for long-term storage.

"The new results have great consequences for underground disposal of nuclear wastes," writes Charles Madic of the Centre CEA de Saclay (part of the French Atomic Energy Commission), Gif-sur-Yvette, France in a commentary in the same issue of Science.

A key factor in favor of burying plutonium waste is the highly insoluable nature of Pu(IV) compounds. But now the safety of those practices needs to be reconsidered, Madic comments in light of the fact that Pu(VI) species are far more soluble and hence more mobile in geological environments. Madic adds that these latest findings also call for "new evaluations of industrial operations involving PuO_2."

Haschke explains that water molecules split into hydrogen and oxygen atoms as water vapor absorbs on solid PuO_2. Oxygen (from water) converts the dioxide into higher oxide:

1. $PuO_2 + x\ H_2O\ \ PuO_2{+}x + 2xH$

In an oxygen-free environment, he says, hydrogen atoms form H_2 that can desorb from the oxide surface.

"But if oxygen is present, hydrogen and oxygen react to form water because it's the thermodynamically favored process," Haschke asserts. That reaction serves to replenish the supply of surface water molecules. The newly formed H2O may then desorb from the surface or dissociate. If it dissociates, then the oxidation process continues and dioxide is converted to higher and higher oxides. Haschke says the group now plans to address environmental plutonium-migration issues.

Response
The comment references relatively recent findings (DIRS 150367-Haschke et al. 2000) dealing with the laboratory observation of a species of plutonium oxide that appears to have a higher solubility than the species most often considered to be the normal oxidized form of the metal (plutonium dioxide). Yucca Mountain project scientists involved in the analysis of long-term performance are aware of these findings and believe they are within the range of the conservatisms already built into the plutonium solubility model used in the modeling.

6.1 (9376)
Comment - EIS001888 / 0081
DEIS Table A-2 indicates that a total of 4.5 billion curies (Ci) were used for the proposed action. It is our understanding that the total number of Ci to be disposed of in the form of spent fuel range from approximately 11 billion Ci up to 19.3 billion Ci.* The documentation available in the DEIS is lacking in a clear and transparent rationale regarding the cause of this reduction from 11E9 Ci's to 4.5 billion Ci and what scientific rationale was employed to validate this reduction.

*Wymer, R.G. and A.C. Campbell. Chemistry in the Proposed Yucca Mountain Repository Near Field. January 2000.

Response
DOE prepared a table in Section A.1.1.4.2 of the EIS to list the relative amounts of radioactivity in various waste types. It is not the total radionuclide inventory used for any analysis. The radionuclides listed in the table were the primary contributors to impacts for various analyses (such as cesium for preclosure, technetium and neptunium for postclosure, and plutonium for the No-Action Alternative). The analyses in the EIS used the inventory specified in Appendix A for the various waste types. See Sections A.2.1 for commercial spent nuclear fuel, A.2.2 for DOE spent nuclear fuel, A.2.3 for high-level radioactive waste, and A.2.4 for surplus weapons-usable plutonium.

6.1 (9704)
Comment - EIS002154 / 0001
First of all, this is a very bad idea. They say 700 or 70 metric tons. That's only the beginning. They're not telling you about the foreign powers that made arrangements to ship their stuff here, also, so you can double that. But they don't tell you that. So all of a sudden we have a mountain full of nuclear waste -- excuse me. Nuclear material. There's nothing waste about it. The life span of that thing is 10,000 years plus. I've never known anything to be a waste that will have that kind of a life span. Can anyone tell me why they use that word "waste"?

Response
The Proposed Action evaluated 70,000 metric tons of heavy metal, and Section 8.2 of the EIS evaluates other material not currently proposed for disposal but that DOE could consider in the future. DOE has evaluated all foreseeable sources of spent nuclear fuel and included them in the inventory. The 10,000-year period is the evaluation period for which the EIS analyses determined environmental impacts, rather than a lifespan. It is based on the regulatory compliance periods specified in the Environmental Protection Agency's *Public Health and Environmental Radiation Protection Standards for Yucca Mountain* (40 CFR Part 197).

The updated analysis in the Final EIS projects that the Proposed Action would likely result in extremely small releases of radioactive contamination to the environment in the first 10,000 years after repository closure (more than 10,000 times less than the individual protection standard set by 40 CFR Part 197).

In addition to the 10,000-year compliance period, DOE has evaluated potential impacts for the period of geologic stability at the repository (that is, 1 million years). This evaluation was performed, in accordance with 40 CFR Part 197, to gain insight into the very long-term performance of the repository and thus provide information for the decisionmakers in making both design and licensing decisions. These results show a mean peak dose rate that is much lower than background levels (see Chapter 5 of the EIS for details).

The amount of foreign spent nuclear fuel that the United States would accept under the Nuclear Non-Proliferation Act is limited to situations in which acceptance is necessary to prevent proliferation of nuclear materials. While the United States can decide to accept foreign fuels under certain circumstances, other countries do not have the unfettered option to send their spent nuclear fuel to the United States. DOE notes that the foreign spent nuclear fuel evaluated in this EIS as candidate material for disposal at the proposed repository is exclusively of U.S. origin on loan to foreign governments for research and other commercial uses such as radiopharmaceutical production.

The terminology used in the EIS, including the term "waste," is consistent with the NWPA and standard industry and regulatory usage. Chapter 14 of the EIS contains definitions for these terms.

6.1 (9759)
Comment - EIS001888 / 0343
[Clark County summary of comments it has received from the public.]

Commenters requested that the EIS identify all waste (and waste characteristics) to be disposed of in the proposed repository. Examples of waste types that should be discussed (for disposal or in confirmation that they would not be disposed) included all waste types in other DOE ElSs and DOE planning documents proposed for geologic disposal, Greater than Class C, special case, weapons-grade plutonium, highly enriched and Navy SNF [spent nuclear fuel], and West Valley SNF and HLW [high-level radioactive waste]. Characteristics that commenters stated were important for the EIS to discuss included fuel type, age, structural characteristics, cladding, and volume of each source of SNF and HLW. Two commenters requested that the EIS identify the order in which the producers/generators would ship SNF and HLW to the repository. One commenter stated that DOE SNF (including Navy SNF) should be received early.

Response
Appendix A of the EIS contains descriptions and characteristics of the materials that DOE plans to dispose of in the proposed repository in accordance with the 70,000-metric-tons-of-heavy-metal limit established by the Nuclear Waste Policy Act of 1982. It also contains descriptions and characteristics of the remaining spent nuclear fuel and high-level radioactive waste and other materials that could require disposal in a geologic repository. The materials described in Appendix A include commercial spent nuclear fuel (Section A.2.1), DOE spent nuclear fuel including naval fuel (Section A.2.2), DOE and commercial (West Valley) high-level radioactive waste (Section A.2.3), surplus weapons-grade plutonium (both as mixed-oxide fuel and immobilized with high-level radioactive waste) (Section A.2.4), Greater-Than-Class-C waste (Section A.2.5), and Special-Performance-Assessment-Required waste (Section A.2.6). DOE would ship the spent nuclear fuel currently stored at the West Valley Demonstration Project in New York to the Idaho National Engineering and Environmental Laboratory before shipping it to a repository, as evaluated in the *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact*

Statement (DIRS 101802-DOE 1995). Section A.2.2.3 lists the inventory of DOE spent nuclear fuel at the Idaho National Engineering and Environmental Laboratory.

The specific characteristics discussed in Appendix A vary with the material type. For commercial spent nuclear fuel, Section A.2.1.5 of the EIS provides information on the various fuel types, typical ages or cooling times, structural characteristics, cladding, and volume. Sections A.2.2 and A.2.3 discuss similar characteristics of DOE spent nuclear fuel and high-level radioactive waste, respectively.

DOE has not determined an actual shipping queue for DOE materials and likely would not until there has been a final decision on a repository. To establish the basis for the transportation analysis, the EIS assumed that DOE would ship commercial spent nuclear fuel from the locations specified in the standard contracts it has established with the nuclear utilities (10 CFR Part 961), and high-level radioactive waste from the farthest sites first. This would result in the shipment of all high-level radioactive waste canisters from the Savannah River Site and the West Valley Demonstration Project with the balance of the 8,315 canisters transported from the Hanford Site, as listed in Section J.1.2.1.2 of the EIS. The EIS also assumed that the Proposed Action would include all naval spent nuclear fuel, with the remaining DOE spent nuclear fuel equally apportioned (approximately 93 percent) from each of the four sites, as listed in Section J.1.2.1.2.

6.1 (9932)
Comment - EIS001860 / 0011
The nation's classifications for radioactive waste need to be updated and improved

Spent canisters used for transportation should not be classified or stored as low-level radioactive waste. The proposal to do so contained in the Draft EIS lends credence to the argument that our definitions of low-level radioactive waste need to be rewritten to exclude many "below class C" items such as these.

Response
The purpose of the EIS is to evaluate the consequences of the Proposed Action to construct, operate and monitor, and eventually close a geologic repository and of a No-Action Alternative. The classification of low-level waste is the responsibility of the Nuclear Regulatory Commission and is, therefore, beyond the scope of this EIS. In addition, the EIS presents the option of disposing of dual-purpose canisters as low-level radioactive waste or recycling them, if appropriate, with regard to protection of the environment and cost-effectiveness (Section 4.1.12.4).

6.1 (10059)
Comment - EIS001888 / 0540
[Clark County summary of comments it received from the public.]

Two commenters asked if the public would be aware of the import locations of military waste bound for the repository.

Response
Appendix A of the EIS provides details of the entire anticipated repository inventory, including defense-related high-level radioactive waste and final waste forms for surplus plutonium. This information includes the assumed location of the materials prior to shipment to the repository. For instance, all of the naval spent nuclear fuel, which is part of the DOE spent nuclear fuel inventory (Section A.2.2.3), would be received from the Idaho National Engineering and Environmental Laboratory.

6.1 (10874)
Comment - EIS000483 / 0002
There are several repository options for DU [depleted uranium]: the YM [Yucca Mountain] Repository, the Waste Isolation Pilot Plant (WIPP), or a new facility.

For several reasons YM is preferred.

1. The health and environmental impact will be low.

The draft YM-EIS indicates that the DU disposal in YM would not significantly impact the environment. Spent nuclear fuel [SNF] is primarily uranium. The analysis shows that SNF uranium (up to 105,000 metric tons) does not significantly contribute to the radiation hazards (Table 5-11) or chemical hazards (pg 5-41) associated with the repository. The health and environmental impact of DU would be less than SNF uranium because DU contains lower concentrations of the more radioactive uranium isotopes. Furthermore, the YM Project has conducted a separate preliminary assessment of the impact of DU on the repository. That assessment(3) also indicated that there would be no significant radiation exposures to the public from adding the DU to the repository.

2. YM is a civilian repository.

YM is designed for those civilian radioactive wastes for which shallow-land disposal is not acceptable or desirable. Much of the DU is from the commercial nuclear fuel-cycle industry and most future DU will be from this source. Acceptance of DU by the YM repository for disposal or use is within the fundamental mission of the YM repository.

3. There are potential beneficial uses of DU in YM that may (1) improve the performance of YM and (2) make YM the low-cost disposal option for DU.

DU may improve the performance of the proposed YM repository. The U.S. Nuclear Waste Technical Review Board(4,5), the Congressionally mandated technical review board for YM, has recommended consideration of the disposition of DU at YM to solve repository nuclear criticality issues and improve SNF disposal. Technical studies(6) have shown how the use of DU in the repository may reduce the long-term radionuclide release rate from the repository. Such use of DU in YM may reduce total costs to the taxpayer and electric-utility ratepayer by avoidance of disposal costs for DU.

References:

(3) Joshua Owen, Potential Disposal of Depleted Uranium in The YMP Subsurface Repository, Yucca Mountain Project Office, U.S. Department Of Energy, Las Vegas, Nevada, July 27, 1999.

(4) U.S. Nuclear Waste Technical Review Board, Report to the U.S. Congress and the Secretary of Energy: January to December 1996, Washington, D.C. 1997.

(5) U.S. Nuclear Waste Technical Review Board, Report to the U.S. Congress and the Secretary of Energy: 1995 Findings and Recommendations, Washington D.C., April 1996.

(6) C.W. Forsberg, "Advanced Spent-Fuel Waste Package Fill Material: Depleted Uranium Dioxide," p. 52 in *Trans. 1999 Winter Meeting American Nuclear Society, Long Beach, California, November 14-18, 1999*, La Grange Park, Illinois, November 1999.

Response

DOE currently stores about 700,000 metric tons of stable depleted uranium in the form of uranium hexafluoride at three locations in Ohio, Tennessee, and Kentucky. The EIS (in Section 4.1.15.3) recognizes the potential benefits of using depleted uranium as a shipping cask material. While depleted uranium could be used in the manufacture of waste packages, the amount of this material far exceeds the quantities that could be used in such packages. However, disposal of depleted uranium as a waste in the Yucca Mountain Repository is not authorized by the Nuclear Waste Policy Act of 1982, which limits disposal to spent nuclear fuel and high-level radioactive waste. Thus, depleted uranium does not meet the criteria for materials that DOE could dispose of in a repository and is not included in the Proposed Action as an acceptable waste form.

Nuclear Regulatory Commission regulations (10 CFR Part 61) indicate that low-level radioactive waste, such as depleted uranium, can be disposed of in near-surface trenches, which is a sufficient and far less costly method than a geologic repository. This disposal option is considered in the *Final Programmatic Environmental Impact Statement* *for Alternative Strategies for the Long-term Management and Use of Depleted Uranium Hexafluoride* (DIRS 152493-DOE 1999). DOE did not choose this option, however, as the preferred option but rather decided to convert its inventory of uranium hexafluoride to a stable form and store the material for potential future use or disposal (64 *FR* 43358; August 10, 1999).

The DOE plan for the conversion of depleted uranium hexafluoride advocates the development of a strategy for future management of depleted uranium. The strategy entails conversion of uranium hexafluoride to an environmentally safer form (either an oxide or metal or both), to enable its constructive use. DOE will continue to keep its options open regarding potential beneficial uses of this material.

6.1 (11116)
Comment - EIS001207 / 0005
According to DOE ROD [Record of Decision] of 1/4/00, Disposition of Surplus Pu [Plutonium], NRC [Nuclear Regulatory Commission] has through some process approved (or tolerated) shipment of 17 metric tons of Weapons grade surplus Pu canned in canisters at the SRS [Savannah river site] for disposal at Yucca Mountain or another candidate pursuant to the Nuclear Waste Policy Act. What procedure was used by NRC, how and when was this done? DOE Yucca Mountain Site Characterization Office has obligation to address the full impacts of the total project during EIS process.

Response
In December 1998, DOE requested the Nuclear Regulatory Commission (NRC) to inform DOE of any potential legal or regulatory provisions that would prevent disposal of immobilized surplus plutonium waste forms and packages in a monitored geologic repository (see December 10, 1998, memo L. Barrett to C.J. Paperiello). On January 25, 1999, the NRC responded that

"The [NRC] staff is not aware of any existing legal or regulatory provisions that would prevent disposal of immobilized plutonium waste forms in a high-level waste repository. The detailed technical evaluation of these waste forms, their packaging, and the principal issues related to these waste (i.e., criticality, safeguards, and impact on repository performance) cannot be performed until DOE finalizes its waste package, engineered barrier, and repository designs and submits its pending license application for the planned high-level waste repository at Yucca Mountain, Nevada… Thus, the [NRC] staff believes that, with adequate canister and package design features and appropriate measures to address the aforementioned principal issues related to these wastes, the immobilized plutonium waste plutonium waste forms can be acceptable for disposal in a high-level waste repository."

Therefore, without giving final approval to ship these materials to Yucca Mountain, the NRC staff has acknowledged only that it is not aware of any legal or regulatory reasons the materials would not be acceptable for disposal at the proposed repository. Final approval to ship, receive, and emplace these materials would be subject to issuance of the NRC license, currently expected in 2010.

The environmental impacts associated with immobilization of the surplus plutonium into the "can-in-canister" waste form are evaluated in the *Surplus Plutonium Disposition Final Environmental Impact Statement* (DIRS 118979-DOE 1999). The impacts associated with the transportation of these canisters to the proposed repository have been evaluated in Chapter 6 and Appendix J of the EIS. The short- and long-term impacts associated with disposal of these canisters in the Proposed Action have been addressed in Chapters 4 and 5, respectively.

6.1 (11343)
Comment - EIS002268 / 0004
The Draft Environmental Impact Statement before us today does not acknowledge the uniquely lethal nature of the waste and fails to provide sufficient information on the unique radiological characteristics of highly irradiated nuclear fuel. Information on the total activities in curies, and the surface dose rates in rem per hour of the assemblies of irradiated fuel is essential for the assessment of risks posed by the transportation and burial of radioactive waste, yet DOE does not provide such data.

According to the State of Nevada, a typical assembly from a pressurized water reactor will contain, even after 26 years of cooling, 31,000 curies of cesium-137 and 21,000 curies of strontium-90, and is a powerful source of penetrating gamma and neutron radiation.

Response

Appendix A of the EIS reports the expected radionuclide inventory in curies for all contributing radionuclides. Section A.2.1.5.2 lists the values on a per assembly basis and the total projected number of curies by isotope for the Proposed Action and the additional inventory modules. The EIS analysis did not require surface dose rates for irradiated fuel, so Appendix A does not provide them. For transportation impacts, the EIS conservatively uses the U.S. Department of Transportation surface dose rate limit for all transportation casks when calculating incident-free risk impacts to the public. In addition, none of the severe accidents evaluated in a recent Nuclear Regulatory Commission report (DIRS 152476-Sprung et al. 2000) would result in a release of spent nuclear fuel assemblies from their shipping casks or a direct exposure to the public. For repository operations, DOE estimated personnel exposures for various activities from shielded elements based on the representative fuel assemblies during normal operations and postulated accidents. In summary, the EIS analysis included all appropriate information required to assess impacts from the spent nuclear fuel and high-level radioactive waste.

6.1 (12245)

Comment - EIS000817 / 0038

As I read p. iii of Volume I you state that the proposed action addressed is for disposal of SNF [spent nuclear fuel] and HLW [high-level radioactive waste] "currently in storage." We don't currently have 70,000 MTHM [metric tons of heavy metal] today, do we? And how rapidly is this going to change with the new fuels and new casks to be used -- MOX mixed-oxide fuel] for example -- and high burnup fuels -- and plant license renewals? You are planning for something you don't know the total of as I understand it -- and there is very little talk of siting a second repository any place. That's kept quiet. My bet is you'll never even attempt it. So "currently in storage" is not valid as I see it. What is really currently in storage, right now??

Response

This comment is correct. There are not 70,000 metric tons of heavy metal (MTHM) currently in storage. DOE has modified the Abstract to reflect this fact. As noted in the table in Section A.2.1.5.1 of the EIS, through 1995 there were 31,926 MTHM of commercial spent nuclear fuel in storage at commercial sites, and from 1996 to 2046, commercial facilities will produce an estimated additional 73,488 MTHM of spent nuclear fuel. As noted in Section A.1.1.2, through 1999 there were 40,000 MTHM of commercial spent nuclear fuel in storage at commercial sites.

6.1 (12278)

Comment - EIS001748 / 0002

Now, these scientific aspects or projections or estimates are exactly the part which are of a greater concern to me. I'm not really that concerned about the cost overruns, but about the safety. It's my understanding that the irradiated fuel rods that you want to ship out to Yucca Mountain will continue fissioning or that are fissioning right now will continue giving off radioactive gases, and I wonder will these gases not build up inside the casks during the transportation process. This fissioning will continue forever, and I'm wondering about gases caused by radiolysis if any residual water comes in contact with the casks and radiation zaps that water, the water molecules break down into hydrogen and oxygen and possibly could cause an explosion of hydrogen gas. This would cause damage to the cask or whatever is supposedly holding this radioactive material at bay and it could have a lot pressure put on it from within over time.

I would like to get back to my original concern about the load producing slowly but gradually increasing amounts of radioactive gases in transport. These gases, I think, are called noble gases because they do not react with other chemicals, but they cannot be filtered and they do break down into other long-lived radioactive materials eventually, and if these gases are inhaled, they can give off radioactive particles within our bodies which will still be emitting radiation, and that's the same stuff that doctors target very specifically to kill cancer cells and they make a patient very ill in the process. And I don't like the idea of this radiation floating around loose in our environment and/or entering parts of our body at random or being in the food and water we ingest. All of these are very real possibilities, and in my mind, probabilities.

I would like you to picture this from the inside out as we're taking about the proposal to transport it out to Yucca Mountain. The material you proposed to transport is "spent" uranium pellets, many of which are fractured to an almost dust-like consistency and this material is spent because it's no longer financially viable or profitable in the reactor, but it's still very radioactive and fissioning and will be for a long, long time. It's encased in damaged metal holders, rods, or whatever they're called, coverings, and that's in bad shape, too, from being in use quite a while. These are enclosed in less than perfect casks and yet you proposed to transport thousands of such dangerous and unstable loads all across the country regularly over a period of 30 years and expect us to believe there won't be any accidents, and that doesn't even include the unfairness to the people who live closer to Yucca Mountain. We're worried about it passing through St. Louis and we're not, according to this proposal, going to have it in our back yards.

Response
This comment is correct that fissioning and gas production (through radioactive decay and radiolysis) will continue to occur in spent nuclear fuel to some degree for many years into the future. Because of these phenomena, waste packages and shipping containers are designed such that internal pressures can be monitored and gases purged as necessary to ensure the safety of workers and the general public. For example, before shipment, the spent nuclear fuel rods are thoroughly dried through a process of multiple purges with dry nitrogen gas and vacuum desiccation. The shipping cask is then filled to a slightly negative pressure with a noncombustible gas such as nitrogen or helium. In addition, internal pressurization is limited (to avoid overpressurization) by design specification determined by considering the very slow rate of gas generation from decay and fission gases. However, comprehensive monitoring and inspection programs required by Federal regulations are in place to detect and correct unexpected pressure conditions prior to shipment.

The comment is also correct in asserting that release of radioactive noble gases and other volatile radioisotopes would occur during handling operations (at generator sites and at the proposed repository). As discussed in Section J.1.3.1 of the EIS, DOE has conservatively estimated that the potential dose to members of the public from such releases would be very low (0.001 person-rem per metric ton of heavy metal of spent nuclear fuel loaded (DIRS 104731-DOE 1986), resulting in no or small impacts.

In relation to the comment's concern about the health hazards of radioactive noble gases "entering parts of our body," the Earth's atmosphere contains radioactive radon (a noble gas) that emanates naturally from soils and rocks in the Earth's crust. Radiation doses resulting from inhalation of this gas (and its decay products) are the principal source of background radiation exposure and result in annual doses to members of the public millions of time higher than those to individuals exposed during spent nuclear fuel handling activities (see Section F.1 of the EIS for details on sources of background radiation exposure).

In relation to potential transportation accidents, the EIS provides a detailed evaluation of impacts that could result from severe accidents (very unlikely) as well as those resulting from incident-free (routine) shipments of commercial and DOE spent nuclear fuel and high-level radioactive waste. Section 6.1.2 of the EIS describes the results of these evaluations for transportation within the State of Nevada, as does Section 6.2 for the rest of the Nation. Appendix J describes the evaluations in detail.

6.1 (12394)
Comment - EIS001887 / 0062
Page 1-26; Section 1.5.3 - Relationship to Other Environmental Documents

Table 1-1 - Draft EIS, Idaho High-Level Waste and Facilities Disposition

The 1995 Idaho/DOE Settlement Agreement (USDC) schedules conversion of all sodium-bearing HLW [high-level radioactive waste] liquid waste in the INTEC Tank Farm into calcine by 2012 and mandates removal of all calcined HLW by 2035. DOE now estimates that treatment will be completed and waste will be "ready for removal" from the Idaho National Environmental and Engineering Laboratory (INEEL) by 2035, but does not guarantee the waste will actually be removed by that date.

The State of Idaho maintains that sodium bearing tank waste is HLW and cites the DOE Order 435.1 definition of high-level waste as "liquid produced directly in reprocessing." Using this definition, the State identifies both sodium bearing and non-sodium bearing waste as HLW. The State of Idaho also includes in its HLW definition liquids from the second and third extraction cycles that were routed to an evaporator before being sent to the Tank Farm and states that "as such, these liquids contain radioactive fission products in sufficient concentrations to warrant permanent isolation in a geologic repository." (DOE says only the liquid from the first reprocessing cycle is

HLW.) Idaho contends that DOE should manage the sodium-bearing waste as HLW unless and until a “Waste Incidental to Reprocessing” determination is made in which the referenced HLW waste would be classified and managed as either TRU [transuranic waste] or low-level waste.

If Idaho’s definition of HLW holds up, volume estimates for HLW from INEEL to Yucca Mountain could change substantially and would put pressure on DOE’s 4,667 MTHM volume commitment for HLW in Yucca Mountain.

Idaho has also formally recommended that DOE allow disposal of HLW containing hazardous waste constituents at Yucca Mountain. If INEEL prevails, other sites would also be in line to ship such wastes to Yucca Mountain, and volume and waste type estimates, as well as the regulatory oversight scenario, would be significantly altered.

Idaho is also challenging DOE’s method for calculating Metric Ton Heavy Metal [MTHM] for HLW because it does not accurately reflect actual concentrations of radionuclides and relative risk, i.e., DOE’s standard says one canister of HLW = 0.5 MTHM. Idaho says this calculation does not recognize the fact that much of DOE’s waste is less radioactive than “typical” waste used in the comparison. Idaho says DOE has overestimated the HLW MTHMs, exceeding the amount allowed in the repository. Idaho further contends that, if other methods of calculating MTHM were used, DOE could stay well within the capacity set for Yucca Mountain and allow INEEL to send larger quantities of its waste to Nevada.

Because waste volumes and types are so central to understanding the entire range of impacts associated with a Yucca Mountain repository, the Draft EIS should have fully evaluated these issues.

Response

The EIS includes an inventory of spent nuclear fuel and high-level radioactive waste based on current Nuclear Regulatory Commission definitions. Appendix A describes the basis for several candidate methods for determining metric tons of heavy metal equivalence for high-level radioactive waste and explains that Congress would have to take legislative action on the equivalence methodology.

The total quantity of high-level radioactive waste that the 70,000-metric-tons-of heavy-metal (MTHM) repository could accommodate varies to a great degree. Since 1985, DOE has consistently used the “historical method” (0.5 MTHM per canister) as a planning basis, and used this method in the EIS to determine the number of canisters of high-level radioactive waste in the proposed repository. Using this method, the repository would contain less than half of the high-level radioactive waste inventory. However, DOE has evaluated the consequences of repository disposal of the entire inventory of this material. Specifically, Chapter 8 of the EIS discusses cumulative impacts for the Proposed Action inventory (which includes less than half of the high-level radioactive waste) and for a Module 1 inventory (which includes the balance of that waste). Using different equivalence methods would shift the proportion of such canisters that the repository could handle between the Proposed Action and Inventory Module 1, but would not change the cumulative impacts because spent nuclear fuel would dominate long-term performance results. Regardless of the equivalence method used, the EIS analyzes the impacts from disposal of the entire inventory of high-level radioactive waste such that conservative consequences are apparent.

Other equivalence methods, including the total radioactivity and the radiotoxicity methods, result in lower estimates of MTHM per canister. These methods would result in acceptance of the total inventory of high-level radioactive waste in the repository. Appendix A of the EIS discusses these methods for information purposes.

The EIS evaluates the environmental consequences of the Proposed Action to construct, operate and monitor, and eventually close a geologic repository to dispose of 70,000 metric tons of heavy metal of spent nuclear fuel and high-level radioactive waste. It also evaluates reasonably foreseeable actions such as the disposal of a greater volume of spent nuclear fuel and high-level radioactive waste that represents the maximum projected inventories of those materials. DOE based the EIS on reference designs, conservative inventories, and conservative methodologies. DOE could consider and ultimately pursue disposal of a greater inventory of materials as long as the EIS evaluated such disposal by analyzing the potential environmental consequences of reasonably foreseeable actions. While the EIS evaluates the environmental consequences of the disposal of more than 70,000 MTHM of spent nuclear fuel and high-level radioactive waste (Module 1 inventory), Congress would set the ultimate capacity of the repository.

DOE does not anticipate that Yucca Mountain waste acceptance criteria would preclude acceptance of high-level radioactive waste from the Idaho National Engineering and Environmental Laboratory following treatment with the exception of the current policy that the waste not be listed hazardous waste. The Department is aware of this requirement and further recognizes that it will have to petition the State of Idaho and the Environmental Protection Agency to delist the waste prior to disposal at Yucca Mountain.

6.1 (12430)
Comment - 010455 / 0004
The nation's classifications for radioactive waste need to be updated and improved.

Response
The purpose of the EIS is to evaluate the consequences of the Proposed Action to construct, operate and monitor, and eventually close a geologic repository and of a No-Action Alternative. The classification of low-level waste is the responsibility of the Nuclear Regulatory Commission and is, therefore, beyond the scope of this EIS. In addition, the EIS presents the option of disposing of dual-purpose canisters as low-level radioactive waste or recycling them, if appropriate, with regard to protection of the environment and cost-effectiveness (Section 4.1.12.4).

6.1 (12590)
Comment - EIS001632 / 0004
Section 1.2.3, page 1-7. The second full paragraph describes the treatment process for high-level waste from storage in waste tanks through solidification. Part of that process "ordinarily includes separation of the waste into high-activity and low-activity fractions." However, after describing what happens to the "high-activity fraction," there is no mention of what happens with the "low-activity fraction." The low-activity fraction is still high-level waste, and this discussion should include the disposition of the low-activity fraction.

Response
As explained in the EIS, the purpose of the pretreatment process is to separate the high-activity fraction, which requires the permanent isolation afforded by a repository, from the low-activity fraction. This large volume of low-activity waste is subject to a "waste incidental to reprocessing determination," as provided for in DOE's Radioactive Waste Management Manual (DOE M435.1-1). A waste stream can be managed as low-level waste if the waste incidental to reprocessing determination shows that it meets the following criteria:

- The key radionuclides are removed to the extent technically and economically practical (this is accomplished by pretreatment).
- It is managed to meet safety requirements comparable to the performance objectives set out in 10 CFR Part 61, Subpart C, Performance Objectives.
- It is managed in accordance with the DOE M 435.1-1 low-level waste requirements and is incorporated into a solid physical form at a concentration less than the Class C limits set out in 10 CFR 61.55.

The Waste Incidental to Reprocessing provision was included in the August 6, 1998, drafts of DOE Order 435.1 and DOE M 435.1-1 that were made available for public comment. DOE has since issued DOE Order 435.1 for implementation.

DOE has modified Section 1.2.3 of the EIS to reflect that low-level waste would be disposed of in accordance with applicable regulations.

6.1 (12605)
Comment - EIS001766 / 0003
When will the Department of Energy and involved energy corporations provide the following: Full disclosure as to whether this plan involves any militaristic uses such as the SSP which is the stockpile stewardship program as listed in Project Censored 1999, also in Nevada; surprise, surprise.

Response
The Proposed Action in this EIS is solely for the disposal of spent nuclear fuel and high-level radioactive waste as specified in the NWPA.

6.2 Waste Handling

6.2 (7660)
Comment - EIS001928 / 0015
Pg. S-59, last paragraph, please clarify the statement "The emplacement of Inventory Module 1 or 2 at Yucca Mountain would require legislative action by Congress unless a second repository were in operation". What that appears to say is that if a second repository is opened anywhere in the country Module 1 or 2 could then be placed in Yucca Mountain without Congressional approval. But what does one scenario have to do with the other?

Response
As noted in Section S.2.2.3 of the EIS, Section 114(d) of the Nuclear Waste Policy Act of 1982 directs that the maximum amount allowed for repository disposal is 70,000 metric tons of heavy metal (MTHM) of spent nuclear fuel and high-level radioactive waste "until such time as a second repository is in operation," even though the Nation will have more than 70,000 MTHM. The statement quoted in the comment from Section S.6.1 is a recognition of the limitations specified in the Act. DOE has modified the text to provide further clarification.

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CONVERSIONS

METRIC TO ENGLISH			ENGLISH TO METRIC		
Multiply	**by**	**To get**	**Multiply**	**by**	**To get**
Area					
Square meters	10.764	Square feet	Square feet	0.092903	Square meters
Square kilometers	247.1	Acres	Acres	0.0040469	Square kilometers
Square kilometers	0.3861	Square miles	Square miles	2.59	Square kilometers
Concentration					
Kilograms/sq. meter	0.16667	Tons/acre	Tons/acre	0.5999	Kilograms/sq. meter
Milligrams/liter	1[a]	Parts/million	Parts/million	1[a]	Milligrams/liter
Micrograms/liter	1[a]	Parts/billion	Parts/billion	1[a]	Micrograms/liter
Micrograms/cu. meter	1[a]	Parts/trillion	Parts/trillion	1[a]	Micrograms/cu. meter
Density					
Grams/cu. cm	62.428	Pounds/cu. ft.	Pounds/cu. ft.	0.016018	Grams/cu. cm
Grams/cu. meter	0.0000624	Pounds/cu. ft.	Pounds/cu. ft.	16,025.6	Grams/cu. meter
Length					
Centimeters	0.3937	Inches	Inches	2.54	Centimeters
Meters	3.2808	Feet	Feet	0.3048	Meters
Kilometers	0.62137	Miles	Miles	1.6093	Kilometers
Temperature					
Absolute					
Degrees C + 17.78	1.8	Degrees F	Degrees F – 32	0.55556	Degrees C
Relative					
Degrees C	1.8	Degrees F	Degrees F	0.55556	Degrees C
Velocity/Rate					
Cu. meters/second	2118.9	Cu. feet/minute	Cu. feet/minute	0.00047195	Cu. meters/second
Grams/second	7.9366	Pounds/hour	Pounds/hour	0.126	Grams/second
Meters/second	2.237	Miles/hour	Miles/hour	0.44704	Meters/second
Volume					
Liters	0.26418	Gallons	Gallons	3.78533	Liters
Liters	0.035316	Cubic feet	Cubic feet	28.316	Liters
Liters	0.001308	Cubic yards	Cubic yards	764.54	Liters
Cubic meters	264.17	Gallons	Gallons	0.0037854	Cubic meters
Cubic meters	35.314	Cubic feet	Cubic feet	0.028317	Cubic meters
Cubic meters	1.3079	Cubic yards	Cubic yards	0.76456	Cubic meters
Cubic meters	0.0008107	Acre-feet	Acre-feet	1233.49	Cubic meters
Weight/Mass					
Grams	0.035274	Ounces	Ounces	28.35	Grams
Kilograms	2.2046	Pounds	Pounds	0.45359	Kilograms
Kilograms	0.0011023	Tons (short)	Tons (short)	907.18	Kilograms
Metric tons	1.1023	Tons (short)	Tons (short)	0.90718	Metric tons
ENGLISH TO ENGLISH					
Acre-feet	325,850.7	Gallons	Gallons	0.000003046	Acre-feet
Acres	43,560	Square feet	Square feet	0.000022957	Acres
Square miles	640	Acres	Acres	0.0015625	Square miles

a. This conversion is only valid for concentrations of contaminants (or other materials) in water.

METRIC PREFIXES

Prefix	Symbol	Multiplication factor	
exa-	E	1,000,000,000,000,000,000	= 10^{18}
peta-	P	1,000,000,000,000,000	= 10^{15}
tera-	T	1,000,000,000,000	= 10^{12}
giga-	G	1,000,000,000	= 10^{9}
mega-	M	1,000,000	= 10^{6}
kilo-	k	1,000	= 10^{3}
deca-	D	10	= 10^{1}
deci-	d	0.1	= 10^{-1}
centi-	c	0.01	= 10^{-2}
milli-	m	0.001	= 10^{-3}
micro-	µ	0.000 001	= 10^{-6}
nano-	n	0.000 000 001	= 10^{-9}
pico-	p	0.000 000 000 001	= 10^{-12}